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MUNICIPAL ENGINEERING

WATERWORKS PARKS

A MONTHLY MAGAZINE.

DEVOTED TO THE IMPROVEMENT OF CITIES.

GOOD ROADS, STREET CONSTRUCTION,
CLEANING AND LIGHTING,
SANITATION,
BRIDGES.

PUBLISHED BY
MUNICIPAL ENGINEERING COMPANY
INDIANAPOLIS NEW YORK

Two Dollars Per Year. Single Copies, 25 Cents.

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Municipal Engineering

VOLUME XI. NOVEMBER, EIGHTEEN NINETY-SIX. NUMBER 5.

MEETING OF AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.

A CRITICAL REVIEW.

The meeting of the American Society of Municipal Improvements at Chicago, October 14 to 17, was not as largely attended as the meeting at Cincinnati a year ago, but was quite successful in furthering the objects of the society by giving opportunity for free interchange of views and experiences. It is rather to be expected, but is none the less unfortunate, that junketing allurements appeal more strongly to many of the delegates than the serious work of the meeting, while a disposition to promote ambitions by manipulations smacking of ward politics experience distinguished some who found nothing in the meeting more worthy of their abilities or efforts. It is hoped for the good of the society that these reprehensible elements, inevitably injurious in their effects, will be suppressed in future meetings, and that the American Society of Municipal Improvements may be known as an organization of high character and usefulness, unmarred by indulgence of mere junketing or self-exploitation of clique domination. A vigorous administration is promised, and if this will take into account the weakening influences to be eliminated, much good will be accomplished toward putting the organization on the high and unquestionable plane that will alone assure it support from the public whose interests it represents.

The committees to whom the programme for the Chicago meeting was intrusted performed their duty very satisfactorily. The Committee on Street Paving, composed of Messrs. A. D. Thompson, of Peoria, N. P. Lewis, of Brooklyn, and S. J. Hathaway, of Marietta, Ohio, presented a number of papers on various phases of that question.

Mr. Lewis' paper on an asphalt testing laboratory gave a description of an inexpensive laboratory, from which results of value in the preparations of specifications for and the inspection of asphalt pavements will ultimately be obtained. The co-ordination of the results of analyses, and the experience with various mixtures on the streets is as yet impossible on account of the lack of data.

Mr. Guthrie's paper on cost of repairing asphalt pavements gave average results with a few figures for individual streets in exceptional cases. Information regarding the cost of repairing a street each year of its life would be of much value,

but no one has yet offered such information, though it would be very easy to so keep the street repair accounts as to readily give the annual cost on each individual street pavement contract.

Most of the papers were statements of local practice in brick, asphalt and wood pavements, and as such were of value as giving what is considered to be the best practice in each locality under the conditions there existing. The evidence is strong that very many cities are still in the experimental stage, and through ignorance of the successes and failures of others, or through mistaken belief that slight differences in local conditions make great differences in practice necessary, are treading over the same paths that others have trod before them, are making similar errors and wasting money in the same old ways. The fact is that the experimental stages are nearly or quite over for many materials, and cities would save much money and many vexatious failures if they would call more frequently upon experts in matters of paving to give the details of experience with the various materials under various conditions.

One good point brought out in the discussion of the subject of testing paving brick was the description by Mr. Holman of the testing laboratory in St. Louis, and the plan and some results of the tests made therein.

The Committee on Electric Street Lighting presented an exhaustive report in two sections upon the details of street lighting plants, as reported by some 160 cities in various parts of the country. Mr. Cabot's paper on Cincinnati's control of electrical construction gave an excellent model for all cities to follow. Few cities, unfortunately, have any control over such matters.

The reports on sewerage and sanitation and on water-works and water supply filled Friday morning's session. There were too many papers to permit much discussion. Prepared papers are, of course, more valuable as a whole than a running discussion, but many members come to such meetings to get information and advice upon special questions, and many items of practice are brought out in discussions which never find their way into formal papers. The same criticism applies to all the sessions to some extent. Better results would be attained if the method proposed when the committees of the society were established could be applied. Each committee was expected to obtain such papers upon the subjects under its charge as were offered by or could be secured from the members of the society, and to prepare abstracts of these papers and a report presenting a general discussion of the subject, supplying deficiencies and collecting the whole into a well digested form for presentation to the society. Time spent in repetition of common facts in the various papers could thus be saved and room made for fuller discussion. If the papers or abstracts could be

cheaply printed for examination by the members before presentation some advantage to the discussion would result. The reports of committees Friday afternoon came nearer this method in the presentation of the subjects than those earlier in the week.

Probably the principal object of the society is the interchange of knowledge, and very many members come to obtain information as to the practice of those older in the work than themselves. It is evidently impossible to touch all the points on which discussion may be desired, but such editing of papers and concentration of effort as the committee scheme makes possible when rightly managed will give the points presented in the briefest possible way consistent with clearness, and will leave time for the discussion to drive home the points of special interest to the members present.

If the papers could be secured by invitation from acknowledged experts in their respective lines who could be present to lead the discussions, the highest good to the society would be reached. There is always a tendency for the better informed members to refrain from the discussion, as they forget that points which are perfectly simple to them are difficult problems to many members of the society, and they hesitate to take up the time of the society in repetitions and in detailing relatively unimportant particulars. Such men placed in charge of the discussions are, however, easy prey for the questioner, and in such position can be made to give practical details in their most approved form. To be sure there are always questioners who are after expert opinions upon their particular problems, and it is sometimes difficult for the questioner to draw the line between legitimate information on the general question and expert opinions which can only be properly given after a careful study of the local conditions. The expert in charge of the discussion can draw his own line. The man of merely local experience presenting a paper is too likely to render such opinion on the spot and is sometimes misleading on account of insufficient general information and insufficient knowledge of local conditions.

Thursday afternoon was occupied by an interesting and instructive excursion along the great drainage canal. Only a glimpse could be obtained in the three or four hours, and no point could receive special attention, but the magnitude and importance of the work was apparent. Fortunately for the society the arrangements made by the Chicago people for entertainment were limited to this excursion and the banquet Friday night. An excursion was proposed for Saturday, but the weather prevented, during which the intake cribs were to be visited and a drive taken over some of the boulevards. Such excursions are of advantage as showing the results of the labors of municipal officers. In such a society, however, great care must be taken that

the excursions do not degenerate into mere junketing trips. The Chicago people were criticised somewhat for their failure to attend the meetings of the society, and by a few for the character of the entertainment offered to the members. Regarding the former, there is nothing to say here, but as regarding the latter, the theory on which the excursions were provided is the proper one, and they were as numerous and as extensive as the exceptionally full programme and the weather would permit.

Two considerations influenced the selection of Nashville as the next meeting place; one the fact that a great exposition is to be held there next year, and the other the belief that it would be well to locate the next meeting in a geographical section hitherto unvisited by the society. The very attractiveness of the exposition is suggestive of the junket. It is a mistake for an organization like this to select meeting places offering counter attractions which tend to divert attention from the purposes for which the delegates are brought together. This was well demonstrated by organizations which held meetings at Chicago in '93 and Atlanta in '95—organizations, too, more independent of public opinion than this. The American Society of Municipal Improvements, however, will learn from experience. Nashville will afford its first lesson in a doubtful experiment. A word of caution may help to avoid the anticipated trouble. Nashville has the reputation of a graciously hospitable city, and such hospitality as may be assured by its invitation is the measure of its responsiblity for the meeting to be held there. The success or failure of the meeting, in realizing the beneficial purposes for which it is held, depends on the delegates who go there tempted by diverting attractions, and who chose the place on account of this temptation.

OUTLINE OF THE PROCEEDINGS.

At the opening session of the American Society of Municipal Improvements, held in Kinsley's hall on Wednesday morning, October 14, a brief address of welcome from Mayor Swift was responded to by President Benzenberg, and after the usual preliminary business, the president read his annual address. In speaking of the objects of the organization, he said:

> Millions of dollars are annually expended in reconstruction, made too frequently necessary by the introduction of improper material, imperfect plans or by the lack of information and experience of those into whose hands such work has been intrusted.
>
> It is not to be supposed that the conditions largely responsible for such state of affairs are likely to be remedied, excepting through the slow process of development toward a more stringent and accountable administration of public affairs. With such evolution, however, this society has no connection, its object being distinctly to improve our competency and efficiency in the discharge of our respective duties by the interchange of experiences, by the presentation and discussion of papers and by preserving in our proceedings for mutual reference and study such practical information as may be collected.
>
> That there is need for better information is evident from the fact that there is not a city whose citizens are not debating and seeking knowledge upon the question of

either street pavements, street lighting, water supplies, sanitation, garbage disposal, municipal control of public utilities, street cleaning, sewage disposal, track construction or a dozen other subjects which arise with the growth and development of cities. How can we get at the experiences and best practice of other cities on these subjects any better than through the medium of this organization with its annual gatherings and opportunities of personal acquaintanceship? Therefore, with the earnest, sincere and hearty cooperation of all its members united to that end, this society in time can not but establish a record of acknowledged utility and benefit to the public unsurpassed by any other organization.

President Benzenberg suggested expanding the work of the society so as to embrace all branches of municipal work, both administrative and legislative, the investigation and discussion of subjects to then be divided into sections. He said:

G. H. BENZENBERG.

The best methods of selecting paving brick, of testing sewer pipes, paving and other cement; the most satisfactory and economical system of cleaning streets, of collecting garbage and ashes, of cleaning or flushing sewers; the best manner of regulating the too promiscuous opening of street pavements by corporations and individual property-owners, of introducing protective sanitary measures in all house plumbing and draining, of securing the best railway track construction in streets; the abatement of smoke and other nuisances; the regulating of traffic by a wagon or tire tax, of providing the best kind of underground service for all classes of wires, of securing to the public a suitable return for all corporate franchises, of enforcing honest competition and honest work on the part of contractors for public works are some of the questions in which all are interested and many of us seek the experiences of other cities.

The rapid development and growth of many cities make necessary that municipal improvements assume a more permanent and durable character, obviating the necessity of frequent reconstruction. Temporary expediencies in municipal work are too frequently expensive mistakes, and should be always discouraged.

It is preferable that progress in improvements be slow so they assume a permanent character and relieve the property-owner as much as possible from the burden of reconstruction. Such practice, of course, is not always in the first instance approved by the taxpayer, but there is no lack of object lessons to demonstrate its economy. Our efforts as an organization should be exerted in that direction, and its work will be more readily appreciated by the citizens when they observe that perfection, durability and economy are the motives which direct our convention labors.

Mr. A. D. Thompson, of Peoria, chairman of the Committee on Street Paving, in a brief report outlining the work of the committee in formulating a programme for discussions on this subject, as well as its consideration of work to be undertaken, introduced the papers to be read on street paving subjects, numbering twelve, as follows:

"Advantages of an Asphalt Testing Laboratory," N. P. Lewis, engineer street construction and maintenance, Brooklyn, N.Y.

"Specification Requirements for Asphalt, Asphalt Mixtures and Tests of Asphalt," A. W. Dow, inspector of asphalts and cements, Washington, D. C.

"Paving Streets with Brick," S. J. Hathaway, chairman street commissioners, Marietta, Ohio.

"Paving in Nashville, Tenn.," J. L. Kennedy, member board of public works, Nashville, Tenn.

"Modern Street Railway Track Construction on Asphalt Paved Streets in Minneapolis," F. W. Cappelen, city engineer, Minneapolis, Minn.

"Testing Paving Brick," A. D. Thompson, city engineer, Peoria, Ill.

"Regulations Concerning the Opening of Pavements by Corporations or Plumbers in the District of Columbia," Capt. Lansing H. Beach, captain corps of engineers, Washington, D. C.

"Regulations for Opening Paved Streets," G. D. Snyder, city engineer, Williamsport, Pa.

"Rumbling of Brick Pavements," E. Adam, engineer board of street and water commissioners, Newark, N. J.

"First Cost and Maintenance of Pave-

ments," W. F. Williams, city engineer, New Bedford, Mass.

"Improved Streets and Care of Same," Col. M. A. Downing, chairman board of public works, Indianapolis, Ind.

"Cost of Repairing Asphalt Pavements," E. B. Guthrie, chief engineer, Buffalo.

Discussion followed each classification of subjects. Many of the papers appear in this number of MUNICIPAL ENGINEERING. Abstracts only can be given of others.

Capt. Lansing H. Beach, captain of the corps of engineers of Washington, D. C., set forth in his paper the police regulations on the subject of cutting into pavements in the national capital. Necessary openings can be made only on the issuance of an official permit, which prescribes the regulations govern-

AUGUST HERRMANN, PRESIDENT.

ing such work. A deposit of $50 is required, and charges for repairs are made in accordance with the following scale: Street pavement, 35 cents per square foot; granite block, 15 cents per square foot and 5 cents for each granite block lost; asphalt block, 15 cents and 7½ cents for each block lost or broken; granolithic, 25 cents; vitrified brick, 15 cents and 2 cents for each brick lost or broken; macadam and telford, 15 cents; cobble, 5 cents. Any plumber failing to make repairs within three days of notice is suspended from license privileges, and the repairs are then made at his expense. Gas, electric light and other corporations whose business necessitates cutting into pavements are required to deposit from $1,000 to $5,000 to cover repairs and as a guarantee of compliance with the regulations. If deemed necessary an inspector shall be employed who shall be paid out of these deposits, $4 per day. Precautions against accidents are required in the specifications.

The paper of Mr. Snyder, city engineer of Williamsport, Pa., showed that in this city an attempt is made to avoid openings as much as possible by requiring all underground work to be done before paving is begun. Permits for openings require the replacing of the pavements and the construction of a concrete foundation spanning the opening, no matter what the original foundation was. This has saved the usual trouble from settlement of the pavement where excavations are made.

The paper of Col. M. A. Downing, president of the Indianapolis Board of Public Works, on "Improved Streets and their Care," described the creosoted wood block pavements recently laid in Indianapolis. The process of treating the wood for this work has been described in previous numbers of MUNICIPAL ENGINEERING. The blocks are yellow pine, 4x6x9 or 12 inches, treated with 12 pounds of creosote per cubic foot, laid on 6-inch concrete foundation. The cost, under a seven years' guarantee, is higher than for other kinds of pavement, but Col. Downing regarded it as preferable. The discussion showed a general prejudice against wood, on account of the unsatisfactory experience with cheap block pavements laid on sand or plank foundations. President Benzenberg said that the wood block pavements, which had generally proved a failure in this country,

could not be justly compared with properly treated blocks, laid on concrete foundations, with proper attention to joint filling, such as are in use in European cities. Such pavements properly laid, however, would not, he said, afford any advantage in cheapness.

The feature of the Thursday morning session was the report of the Committee on Street Lighting read by Mr. J. A. Cabot, of Cincinnati, the chairman. It gave a well tabulated comparative statement of the cost, operating expenses, earnings, etc., of electric street lighting plants in 100 cities. It was followed by a paper by Mr. Cabot on "Municipal Control and Inspection of Electrical Construction in Cincinnati."

Thursday afternoon was occupied with an excursion along the Chicago drainage canal, constructed at a cost of $30,000,000.

At the evening session Dr. Prendergast, of Cincinnati, chairman of the Committee on Nomination of Officers, and M. L. Sherrerd, of Newark, chairman of the Committee on the Selection of the Next Place of Meeting, presented reports which were adopted without dissent. Nashville was chosen as the meeting place and the nomination of the following officers for the next year was concurred in by directing the secretary to cast the vote of the Association for their election:

President—August Herrmann, president of the board of administration, Cincinnati, Ohio.

First Vice-president—E. B. Guthrie, chief engineer of Buffalo, N. Y.

Second Vice-president—W. R. Kerr, health commissioner of Chicago, Ill.

Third Vice-president — Ernest Adam, city engineer of Newark, N. J.

Secretary—D. L. Fulton, street commissioner of Allegheny, Pa.

Treasurer—J. L. Kennedy, board of public works, Nashville, Tenn.

Committee on Finance—L. W. Rundlett, St. Paul, Minn.; F. J. O'Brien, Oswego, N. Y., and G. F. Munro, Omaha, Neb.

Brief remarks were made by each of the newly elected officers in response to calls from the meeting.

No formal report was made by the Committee on Sewerage and Sanitation, but two papers were presented, the first by Capt. Lansing H. Beach, on "Construction of Sewers in Washington and the District of Columbia," in which he described methods of constructing pipe sewers to prevent root intrusion, made necessary in Washington by the trouble experienced from growth of roots from the great number of shade trees along the streets there. The plan adopted

E. B. GUTHRIE, First Vice-President.

was to bed the pipe in concrete on the bottom and sides and at the joints to carry a four-inch thick ring of concrete over the top. Hub and spigot joints were not used in this construction, which had been very efficient for the purpose intended.

Mr. G. L. Clausen, superintendent of the sewer department of Chicago, read a paper on "Sewers and Sewage Disposal in Chicago," in which he described the plans adopted for the sewerage of Chicago and the proposed utilization of the drainage canal, which was followed by many inquiries, chiefly applying to local conditions. Geo. H.

Frost, chairman of the Committee on Sewers at Plainfield, N. J., described at some length the sewage disposal plant constructed there.

Harrison Van Duyne, of Newark, N. J., chairman of the Committee on Water-works and Water Supply, submitted a report outlining questions for particular study, embracing the growth of algae and other organisms, trouble from anchor ice at gate houses, and sewage pollution. Papers were read as follows:

"Purification of Chicago Water Supply," J. W. Hill, consulting engineer, Cincinnati, Ohio.

"Water Works and Filtering Arrangements, Nashville, Tenn.," by J. L Kennedy,

W. R. KERR, SECOND VICE-PRESIDENT.

member board of public works, Nashville, Tenn.

"Filtration of the Water Supply of Davenport, Iowa," by E. W. Boynton, commissioner public works, Davenport, Iowa.

"Biology of Water, Microscopical Organism and the Determination of Quality," by A. S. Tuttle, assistant engineer bureau of water, Brooklyn, N. Y.

Mr. Hill and Mr. Tuttle were not present. There was no discussion following the papers.

G. F. Munro, of Omaha, chairman of the Committee on Taxation and Assessment, submitted a carefully prepared and quite elaborate report. After discussing the general principles of special assessments the report said:

The very idea of special assessment precludes the soundness of all objections on the ground that the apportionment departs from the ratio of ability to pay, unless it be contended that no public burden not imposed according to the ability of the contributor to pay can ever be regarded as just. Whatever be taken as the evidence of ability to pay special assessments for benefit will be seen to be unpardonable sinners against the rule adopted. They are not levied in the ratio of the value of the property, for it frequently occurs that a worthless strip is increased in value to a greater extent than a valuable one. Neither do they conform to the variations of income, for an owner who derives no income from his property may be subject to as heavy an assessment as another who receives in rentals from a tenant a fair return each month. Nor do they bear relation to the expenditures of the assessed, for the present purposes to which property is devoted are immaterial to the assessor. If there be any injustice in a special assessment it must lie in this: Where an expense is to be incurred by a local authority which results in special distinct and measurable advantages to the property of particular individuals, it is more equitable that those who benefit thereby should contribute to the expense to the extent of those benefits than that the burden should be placed upon others who have received no such special benefits.

Charles Carroll Brown, chairman of the Committee on City Government and Legislation, presented a very full report, reviewing at length the progressive steps in better municipal government, and explaining the advantages of the charter regulations of Brooklyn, St. Louis, Indianapolis, Milwaukee and other cities. The committee recommended terms of from four to six years for mayors, and on the subject of the management of public works the report said:

The great principle to be followed is that of continuity of policy and management regarding public works. The principle is quite the opposite of the great American principle of rotation in office, of change simply for the sake of change, but as the period of public extravagance passes living gets closer and the beauties of economy begin to show themselves, the loose methods of making public expenditures now in vogue will go out of fashion and the better methods will begin to come in. A great assistance in securing the continuity spoken of will be some form of civil service examination whereby the best men can be secured and retained during good behavior. At present we have on the one hand those who would give us a "business administration," and as they have no civil service examinations in their own business,

therefore need none in their administration of city affairs. They forget that their methods of securing and advancing men in their employ are the best form of civil service examination, and that their business goes on for years under the same management, while the city officers change at frequent intervals and are strangers to most of the men in the subordinate offices. It is to be noted that the men giving a "business administration" are those who make the cleanest sweep of the offices when they get into power. Another point not to be forgotten is that of favoritism, whether political or personal. Few large establishments are free from this drawback to good work. Many railroad systems are overrun with it. In its political form it is the curse of city affairs. On the other hand are those who would eliminate all personal element by an inflexible system of examinations and appointments thereunder, which in its strict application is the death of all progress in the direction of non-partisan appointments, because it is so obnoxious in many of its features, and fails to secure the results desired, being too apt to give the offices to unpractical men who are better with their pens or tongues than in doing the practical work to be assigned. Modifications which admit more opportunity to select the practical man from among those with sufficient knowledge are sometimes presented, and with honest administration, such as would be encouraged by the method of appointing heads of departments proposed, will give better results than either extreme method. Methods of examination should also have some flexibility, that the applicant may have an opportunity to show his capabilities in his best way, rather than try to show them in the unfamiliar way fixed by the ordinary examining board.

If the board is not all engineers, it should have (the city engineer being president) at least one good business man and an architect, builder, engineer or technical man of similar character, and if possible, one who is thoroughly familiar with all branches of the city's work. Members of the board come into this knowledge if retained long enough. An attorney is sometimes a good selection.

No report was presented by the Committee on Disposition of Garbage and Street Cleaning, the Chairman, L. H. Johnson, of New Haven, not being present. However, a paper by Dr. Walter Kempster, of Milwaukee, who also was not present, was read. It was on "The Method of Treating Garbage in Milwaukee."

M. R. Sherrerd, engineer of the water-works of Newark, N. J., presented a short paper on "Some Phases of the Gravity Supply and Steel Conduits of Newark."

At the close of the session President Herrmann announced the appointment of standing committees for the next year as follows:

Street Paving—A. D. Thompson, Peoria, Ill.; Nelson P. Lewis, Brooklyn, N. Y.; W. G. Wilkins, Allegheny, Pa.

Electric Street Lighting—J. A. Cabot, Cincinnati, Ohio; F. W. Cappelen, Minneapolis, Minn.; J. H. Pearson, Louisville, Ky.

Sewerage and Sanitation — George H. Frost, Plainfield, N. J.; M. A. Downing, Indianapolis, Ind.; Peter Weidner, Dayton, Ohio.

Water-works and Water Supply—E. H. Keating, Toronto, Ontario; M. L. Holman, St. Louis, Mo.; M. R. Sherrerd, Newark, N. J.

D. L. FULTON, SECRETARY.

Taxation and Assessment—G. F. Munro, Omaha, Neb.; S. C. Hathaway, New Bedford, Mass.; R. E. Horner, Parkersburg, W. Va.

City Government and Legislation—C. C. Brown, Indianapolis, Ind.; C. C. Waddell, Chillicothe, Ohio; L. E. Farnham, Camden, N. J.

Disposition of Garbage and Street Cleaning—Dr. J. L. Hess, Cleveland, Ohio; Frank V. Matty, Syracuse, N.Y.; S. Brockman, Milwaukee, Wis.

Review—Lansing H. Beach, Washington, D. C.; Capt. M. M. Drake, Buffalo, N. Y.; E. W. Boynton, Davenport, Iowa.

A banquet was tendered the delegates by the local committee of arrangements, at Kinsley's, on Friday evening. There were responses from representatives of several cities and a number of Chicago officials. Arrangements were made for an ex-

cursion on Saturday to the waterworks intakes in Lake Michigan, and a ride from Jackson Park by Columbian coaches, but severe weather prevented this.

DELEGATES IN ATTENDANCE.

Allegheny, Pa.—W. G. Wilkins, D. L. Fulton.
Akron, Ohio—S. W. Parshall.
Buffalo, N. Y.—M. M. Drake, Thos. Maloney, Edw. B. Guthrie.
Brooklyn, N. Y.—N. P. Lewis.
Binghamton, N. Y.—D. E. Monroe, E. Whalen.
Bridgeport, Conn.—F. E. Clark, Benjamin Miller, F. W. Beers.
Bloomington, Ill.—W. P. Butler.

J. L. KENNEDY, TREASURER.

Camden, N. J.—L. E. Farnham, W. H. Tice, H. J. Sharp, E. S. Mills, Charles P. Sayr, John Blome.
Chillicothe, Ohio—Geo. E. Mosher, Chas. A. Kentinge, Geo. L. Einmel, C. C. Waddle.
Cincinnati, Ohio—H. J. Stanley, J. A. Cabot, F. C. Kerr (*Tribune*), A. P. Butler, R. H. Warder, Aug. Herrmann, John Frey, John B. E. Bogen, Geo. T. Sterritt, Willis P. Thorp, Fred Amthauer, J. W. Prendergast.
Champaign, Ill.—A. N. Talbot.
Concord, N. H.—W. B. Howe.
Cleveland, Ohio—J. L. Hess.
Covington, Ky.—W. H. Glore, Thos. H. Kennedy, J. L. Rhinock, D. Seger.
Dayton, Ohio—Charles E. Rowe, B. B. Childs, A. F. McGregor, Peter Weidner, O. E. Davidson, T. B. Backus, F. M. Turner, W. F. Miller.
Davenport, Iowa—E. W. Boynton.
Dubuque, Iowa—W. H. Knowlton, H. B. Griffiths, John F. Stearn.
Eau Claire, Wis.—C. A. Alderman.
Ft. Wayne, Ind.—Wm. Meyer, Jr., Chas. Haraig, A. Barkenstein, Peter Engerman, A. M. Schmidt, P. H. Kane.
Indianapolis, Ind.—M. A. Downing, J. B. T. Jeup, William Fortune, Charles Carroll Brown.
Jonesville, Ohio—F. R. Farquhar.
Kalamazoo, Mich.—J. R. McCall.
Lafayette, Ind.—W. K. Eldridge.
Louisville, Ky.—Joseph Nevin, J. L. Dunlap, J. H. Pearson.
Minneapolis, Minn.—F. W. Cappelen.
Marietta, Ohio—S. J. Hathaway, Phil. Bachman, B. F. Woof, Jacob Rech.
Milwaukee, Wis.—G. H. Benzenberg, S. J. Brockman, Fred Schneider, Paul Muenzberg.
Nashville, Tenn.—John L. Kennedy.
Newark, N. J.—H. Van Duyne, William Stansby, Abram Joralemon, Ernest Adam, William Greathead, Peter Hubreck, John Burkhardt, M. R. Sherrerd.
Nashua, N. H.—John F. Stark.
Newport, Ky.—W. L. Glazier, John Surran, Jas. Kewblock.
New Bedford, Mass.—S. C. Hathaway, Chas. O. Brightman, W. S. Cook, A. L. Blackmer.
Omaha, Neb.—G. F. Munro, Frank J. Kasper.
Oswego, N. Y.—F. J. O'Brien.
Peoria, Ill.—Will O. Clark, A. D. Thompson, Jacob A. Harmon.
Plainfield, N. J.—Geo. H. Frost.
Parkersburg, W. Va.—H. H. Moss, R. E. Horner, W. W. VanWinkle, W. N. Chancellor, R. H. Thomas.
Quincy, Ill.—D. F. Dederick.
Syracuse, N. Y.—Russell R. Stewart, Robert Ballard, Frank V. Matly, Duncan W. Peck.
South Bend, Ind.—W. M. Whitten.
St. Paul, Minn.—L. W. Rundell, John Copeland.
St. Louis, Mo.—Robert E. McMath, M. L. Holman, B. H. Colby, F. L. Ridgely, C. H. Stone, A. M. Milner.
Sheboygan, Wis.—C. N. Boley.
Toronto, Canada—E. W. Keating, John Jones, Bernard Sanders, John K. Lesker.
Toledo, Ohio—C. S. Brown.
Washington C. H., O.—H. B. Brownell.
Williamsport, Pa.—Geo. D. Snyder.
Washington, D. C.—Lansing H. Beach, W. C. Woodward.
Youngstown, Ky.—Veeder Heasley.
Youngstown, Ohio—R. Kurtz, G. M. Lillie, John DeVenire.

ADVANTAGES OF AN ASPHALT TESTING LABORATORY.

By N. P. Lewis, Engineer of Street Maintenance and Repairs, Brooklyn.

It must be admitted that the chemical properties of asphaltum and the other materials which are combined to form the asphalt pavement usually laid in this country at the present time, what change, if any, these elements undergo when mixed together, and what physical and chemical changes take place in the pavement after subjection to street traffic and exposure to the weather, are subjects which to the municipal engineer are usually shrouded in mystery. Nor is this surprising. Such pavements are usually laid under a guarantee of from five to fifteen years and the contractor is very likely to take the ground that he knows from long study and experience just what treatment and mixture will give the best results with his particular material. And if the engineer ventures to insist upon any variation from the methods he wishes to follow why he, the contractor, will not be responsible for the results. He will tell you that Prof. ——, the company's consulting chemist, has devoted a lifetime to the study of the subject, and has prescribed a certain mixture and, of course, he knows what will give the best results.

The engineer is thus placed in a difficult position and is quite likely to accept the contractor's view, while the same is true to a greater degree in the case of the administrative officer at the head of the Public Works Department, who is almost invariably a man without technical training.

The laying of asphalt pavements in American cities has, up to within a very few years, been almost wholly done by one or two companies who obtained their material from a single source, and it was therefore of about the same quality, and, as similar methods were followed, the results were fairly uniform, and, upon the whole, satisfactory.

New sources of supply have recently been developed, and it has frequently happened during the past year or two that, where specifications have been so framed as to admit any material meeting certain specified requirements, five or six bidders have submitted proposals for laying as many different kinds of asphalt. The municipality should be in a position to profit by this competition. Few, if any, of the new companies are able to refer to pavements which have been laid for five years or more, and, time being the best, and, in many instances, the only testimonial of value, the engineer is in doubt as to whether some of the proposals should be considered. It is generally deemed wise to let others do the experimenting, and, when results have been assured, profit by their experience. The asphalts furnished from different localities differ very materially in chemical and physical characteristics and each requires special treatment. Many

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of the new companies are still feeling their way and do not seem satisfied as to the best treatment of their material under given conditions of climate and traffic.

The writer's own experience may have been exceptional, but with thirteen contracts carried out by one of the new companies in 1895, he is convinced that not less than six different mixtures were used in laying pavements which would be subject to conditions which were identical.

The engineer is not and cannot be expected to be a chemist, though he should have a general knowledge of the properties of asphalt and should be capable of outlining the investigations to be made, while a young graduate of a good tech-

nical school, who has made chemistry the special feature of his course, can carry out the work which may be indicated. The writer is not a chemist and his intention is not to prescribe the best method, or any method of conducting a laboratory for the purpose described, but to urge upon municipal officers the necessity of an independent investigation of materials and methods, that they may be able to know exactly what is given them under contracts for asphalt pavements, to correct irregularities and variations in the product, and if results should be unsatisfactory, to indicate the cause and prescribe the remedy. In a word, the engineer should know at least as much about the subject as the contractor.

Judging from the published reports of the engineers of various cities, almost nothing has been done in the line of analysis, or even observation and record of the pavements after they are laid. With one or two notable exceptions these reports consist merely of a dry recital of the streets which have been paved, the area of the pavement laid, the mileage and total cost. When exceptional efforts are made to be explicit the character of the work is more fully described, the cost of the different items and cost per unit of measure are given. There is little, if anything, which will add to the general information on the subject, or be of benefit to other municipal engineers.

I do not think that the results which may be obtained from observation and experiment should be regarded as personal capital of the observer or experimenter, but should be added to the general knowledge of the subject and given to the profession. Without any desire to be personal, I think an outline of the work done in a modest little laboratory recently established by the writer may be of value.

As the result of an earnest request the common council of the city of Brooklyn authorized the equipment of a laboratory for chemical and physical tests of paving material at an expense of $1,000. An unused corner on the top floor of the building in which the public works department is housed was partitioned off, and the necessary closets, shelving, fume chamber, gas and water pipes were put in. The services of a young graduate of a local technical school, who had for two years after graduation acted as an instructor in quantitative analysis, were secured at a salary of $1,000 a year. An outline of the work to be done was given him, the methods discussed, and apparatus and chemicals essential for the purpose were provided. The cost of fitting up quarters was $365, while that of apparatus and supplies was $650, an excess of $35 over the amount appropriated. A list of the supplies purchased it is unnecessary to give, but the items may be summarized as follows:

Glassware (flasks, beakers, condensers, etc.)	$ 95
Bottles ("Reagent," "Saltmouth," "Tinctures")	35
Chemicals	70
Platinum (crucibles, dishes, etc.)	80
Analytical balance	60
Balance for large weighings	30
Gas stoves, Bunsen burners, ring stands, clamps, etc	30
Miscellaneous apparatus and accessories	250
Total	$650

It should be noted that the laboratory was equipped for general analytical work, it being found that the additional cost required to make it complete was trifling when compared with the expense involved in fitting it for asphalt work alone. It was considered poor economy to prepare for asphalt work only and leave ourselves unprepared to make any simple test or determination not strictly in that line.

Early in May we were prepared for work. The scope of the investigations has thus far been modest, and the analyses made are about as follows:

Frequent visits are made to the plants of the different companies and samples of crude and refined asphalt, petroleum residum, or maltha, with the asphaltic cement, limestone and sand are frequently taken, and partial or complete analysis made. The inspector on the street is always provided with a thermometer to test the temperature of the paving mixture as delivered and laid. Samples of the new pavement are taken from each block, and the location actually recorded. As many as possible of these samples are analyzed at once, a determination being made of the amount of matter soluble in bi-sulphide of carbon, the percentage of matter volatile at a fixed temperature, and, in a number of cases, in each different kind of material which was laid, the percentage of petroline and asphaltine is determined Special note is also made of the physical characteristics of the insoluble residue, particularly of the variations in size of the particles. The remainder of the sample is filed away for future reference, the intention being to make examinations of the pavement taken from the

same locality at subsequent times and see what changes shall have taken place in the material in the street which has been subjected to traffic of known density, under various degrees of temperature, humidity, etc., and in that which has been lying upon the shelves of the laboratory.

In the asphalts a determination is made of the total bituminous matter, dividing it into petroline and asphaltine, the organic matter, not bitumen, the mineral matter, the specific gravity of the asphalt, etc.

Flash and fire tests are applied to the petroleum residuum oils and their specific gravity is determined, the use of an uniform quality of residuum oil being of great importance. In case a maltha or liquid asphalt is used, as in the practice with the California asphalt, the same tests are applied, while the amount of matter soluble in bi-sulphide of carbon is determined, as well as the percentage of water and matter volatile at 250 degrees F.

The results thus far obtained have been interesting and have established the reason for several phenomena which were observed, but their greatest value will not be realized until the pavements can be observed after several years of use, while a study of these analyses in connection with data as to the cost of maintenance and of the volume of traffic which the pavement has sutained should add materially to the general knowledge of the subject and aid in determining the best treatment for the different products.

It is very satisfactory to the engineer to be able to determine the actual cause of any failure or unusual condition which may be observed. Thus when in completing a contract with Alcatraz asphalt the last 100 feet laid appeared suddenly to have lost all its cohesiveness and was not consolidated by the roller, an examination showed that the mixture contained but 4.46 per cent. of matter soluble in bi-sulphide of carbon, while that which had previously been laid showed 8.75 per cent. Of course the contractor lost no time in removing it, but it showed that there was carelessness somewhere. As there was no change made in the mixture the conclusion was that the tanks were worked too low and a large amount of mineral sediment was drawn off into the cement. This might have occurred to a much less degree, so as not to have been noticeable and yet resulted in a piece of pavement so low in bitumen as to become friable and disintegrate in a very short time.

Another case was that of a pavement which in its second summer appeared considerably softer than when first laid, certain spots of limited area being so plastic that a hole could be made entirely through the wearing surface with the heel of one's shoes, while in a few hours it would resume its normal surface. Laboratory examination of the pavement from one of these soft spots showed that in the upper surface the percentage of soluble bituminous matter was 10.74, at the bottom 15.69, while an average sample from top to binder showed 12.91 per cent., and at the bottom next to the binder were found portions of asphaltic cement entirely free from sand. This street was one of the first laid with a binder formed of asphaltic cement instead of coal tar, and the trouble was undoubtedly due to the fact that in spreading the binder course an excess of the cement accumulated at these places which in time soaked up into the wearing surface forming a mixture too rich in bitumen to sustain ordinary street traffic in hot weather. The same trouble has occurred in pavements laid with tar binder. The necessity is thus shown of carefully removing these portions of the binder where an excess of tar or asphalt appears and substituting the standard mixture. This will sometimes occur in the work of the most expert contractor, and the inspector should be instructed to insist upon the removal of such patches.

Reference was made above to the sizes of the particles of the mineral and other insoluble matter which form about 90 per cent. of the paving mixture. It appears to the writer very important that the sand should be so selected as to show such a graduation of sizes that the voids will be reduced to a minimum. It is well known that the very best asphalt will not resist oxidation if the pavement be porous, and the more perfectly the voids be filled the better will the pavement be able to resist the wear and tear of street traffic.

An examination of a number of paving mixtures showed the following variations in the size of the insoluble residue, the results given being the average of the samples of each kind of pavement which were examined.

Percentage of Total Insoluble Matter Retained on Sieves of Different Mesh.

Kind of Asphalt Used.	10 Mesh.	20 Mesh.	40 Mesh.	60 Mesh.	80 Mesh.	100 Mesh.	Finer than 100.
Trinidad Lake	4.60	13.43	27.23	21.42	9.20	1.97	19.15
Trinidad Land	0.07	1.11	15.30	53.87	7.42	1.14	21.09
Alcatraz	0.05	0.74	13.54	38.70	17.61	4.26	25.10
Bermudez	0.03	7.34	24.10	31.99	13.42	2.19	20.93

Of course the kind of asphalt used bore no relation to the sizes of the insoluble matter, which were governed by the quality of sand selected for the pavement, and it was given only to identify the contractors using it. It will be seen, however, that the variation is considerable, while there were marked differences in the specimens laid by the same contractor, although the sand used was supposed to be the same. The variations in the percentage of bituminous matter found in the different pavements tested are given below:

Percentage of Matter Soluble in CS_2

Kind of Asphalt Used.	Highest.	Lowest.	Average.	Range.
Trinidad Lake	9.95	9.31	9.655	0.64
Trinidad Land	10.36	9.94	10.15	0.42
Alcatraz	9 08	8.20	8.673	0.88
Bermudez	9.74	8.48	9.108	1.26

This shows that the contractors using Trinidad lake and Trinidad lind asphalt were able to control their mixture somewhat better than the others.

The chief present value of these results is to enable the engineer to discover any tendency to carelessness or irregularity and put him on his guard, while it is expected that they will be extremely useful in subsequent observations of the pavements.

Specimens are being collected from the older pavements where openings are made, and these will be analyzed during the winter and general conclusions can be reached as to the changes which the material has undergone. Too much importance cannot be attached to the practice of carefully recording every incident connected with the laying of the pavement, the temperature and other conditions prevailing, the character of the foundation, etc., while records should also be preserved of the density and character of the traffic. These should all be compiled in form convenient for reference, and there is little doubt but that in many cases of short-lived and unsatisfactory pavements an intelligent examination of the laboratory and office records will disclose some sin of omission or commission to which the defect can be clearly traced.

The general methods followed in the examination of refined asphalts were those outlined by Miss L. A. Linton.*

In the case of pavement mixtures, the samples after having been pulverized in the mortar, were weighed out in a suitable flask and disintegrated with successive portions of bisulphide of carbon, the solution being each time decanted into a settling jar. This solution, freed from all sediment, is poured into a flask connected with a condenser, the solvent evaporated and the residue weighed.

When time permits this extracted matter is further examined in the same manner as the refined asphalts, specially with a view to the detemination of the petroline and asphaltine.

It is not expected to confine our work to the examination of asphalt alone, but analyses are now being made of a number of specimens of vitrified brick, a determination being made of silica, alumina, iron, lime and magnesia, entering into their composition, while the specific gravity and the capacity of absorption are found. Of course, all cements used on

* Municipal Engineering, No. 1, Vol. viii; Journal of the American Chemical Society, Vol. xvi, 1, 809.

street paving work are carefully tested in the same laboratory. This work is simply referred to, however, as it is assumed that the physical tests at least of brick and cement are invariably applied. It will be found that the more interesting investigation of the materials and methods used in the laying of asphalt pavements can be made at very slight additional expense.

This brief outline of the work done and the objects sought to be attained is submitted in order to show that a simple laboratory can be established and maintained at a very slight expense, while the results obtained will tend to give the engineer far better control of the work, and enable him to avoid mistakes which will be many times as costly, and at the same time enable the municipality to profit by the competition now existing among the different asphalt companies.

SPECIFICATION REQUIREMENTS FOR ASPHALT, ASPHALT MIXTURES AND TESTS.

By A. W. Dow, Inspector of Asphalts and Cements, Washington, D. C.

The request is frequently being made for a knowledge of the methods by which an asphalt suitable for street paving may be distinguished, and for a practical set of specifications for an asphalt mixture. Little has been written and but little known, but the enormous increase in paving streets with asphalt throughout this country in the last five years has made the subject one of general interest. In my effort to throw a little light on this subject I am hampered by the thought that practically everything is in the crude state of a beginning and that no standards have as yet been fixed for any tests.

As there is at present some confusion as to the meaning of certain terms used in this article, I feel it advisable to define their meaning as employed here.

Bitumen—Any and all hydrocarbons, whether natural or artificial, soluble in carbon di-sulphide.

Asphaltum—A natural bitumen, all or a portion of which is insoluble in petroleum naphtha, and in most cases found associated with various mineral and organic substances.

Asphalt—Any and all natural depoeits containing asphaltum.

Asphalt Cement—An asphalt or allied substance softened by some softening agent. Or an asphalt of the proper consitency for use in paving. It may be more or less pure.

A properly constructed pavement should be composed of the three parts—base, binder and wearing surface.

Base—As in all pavements, the base should be given the closest attention. It is a false economy to try to save on the base. It is well in the constructing of a pavement to consider that the base is the true pavement, and there is no reason why it should ever be reconstructed. The wearing surface is intended to take the wear and tear of traffic and can be replaced on the same base times innumerable. It should be made of concrete of at least six inches in depth, on a well-compacted bed, unless it should be desirable to lay a wearing surface on an old stone or macadam pavement. It is not, however, desirable to remove a stone pavement, lower the grade, replace the stones and then lay on the wearing surface, as it is impractivable to relay the stone pavement with sufficient care to present parts of it from compacting more than others, which will in time produce depressions in the wearing surface.

Binder—As the surface of the base is comparatively smooth and of such a character that the wearing surface would have no bond with it, it is found necessary to use what is called a binder. This binder, as the name implies, is intended to bind the surface coat to the base, thus preventing it from showing under traffic in warm weather while in a soft condition. It should be composed of angularly broken stone of varying sizes, mixed with soft asphalt cement.

Wearing Surface—It should be composed of a sharp-grained sand containing some dust and an asphaltic bitumen. Too little importance in the past has been paid to the selection of the sand and dust for asphaltic mixtures, and many failures have resulted therefrom, which were considered due to other causes. It would not be far from right to say that it is possible by varying the grade of sand and the quantity of dust to produce any character of pavement desired without changing the bitumen. Indeed the sand and dust are of as much impor-

tance in the making of a good pavement as the asphalt. In selecting a sand certain rules should be observed. It should be moderately fine, the grains varying in size from coarse to fine, the fine predominating. A good sand on sifting should give proportions somewhat similar to these:

Retained on 10 mesh per inch sieve	0 per cent.
Retained on 20 mesh per inch sieve	12 per cent.
Retained on 40 mesh per inch sieve	25 per cent.
Retained on 60 mesh per inch sieve	20 per cent.
Retained on 80 mesh per inch sieve	10 per cent.
Retained on 100 mesh per inch sieve	18 per cent.
Passing through 100 mesh per inch sieve	15 per cent.

All the grains retained on a sixty-mesh sieve must be hard, as it is desirable that they resist being crushed by traffic. This is very important, and a number of pavements have failed for no other reason than that the coarse grains were crushed, producing numerous smaller grains that were uncoated by bitumen. A proper grading of the sand from coarse to fine, with considerable fine, is desirable, as it permits the use of more and a softer bitumen. To understand the desirability of this it is well to remember that all bitumens harden by the fall of temperature, and that at some low degree they tend to be more or less brittle. If so fine a sand be employed that the bitumen used may be so soft that the degree of temperature at which it would become brittle is below the minimum of atmospheric temperature, we can prevent our pavement from becoming brittle.

A round-grained sand is to be avoided, as it produces a much softer mixture than an angularly grained sand would, though the same bitumen be used with both. It is but seldom that a properly graded sand is found, and especially one containing the requisite quantity of fine. To overcome this difficulty two or even more sands are often mixed, and more often some suitable dust is mixed with it. This dust should be any inorganic substance unaffected by water. In the selection of a sand for a mixture the earthy matter of the asphalt cement must be considered as a part of the sand.

Bitumen—The bitumen may be derived from various sources, as a suitable mixture of a hard and soft asphalt, a hard asphalt with an asphaltic oil from an asphalt found naturally to contain a bitumen of proper consistency or a hard asphalt softened with an artificial product. As there are practically no artificial bitumens used alone in street paving I will only deal with those derived from natural origin and of mixtures of natural and manufactured products.

The necessary characteristics for a bitumen to possess are adhesiveness, cohesiveness and elasticity to a certain degree. It must not show too rapid a change with ageing; must be practically unaffected by water or dilute ammonia, and have a proper degree of consistency or softness. Its consistency should not be greatly altered by changes in temperature, and lastly, a certain degree of stability upon being kept at a high temperature for a length of time.

If in the examination of an asphalt or like substance to determine its suitability for paving one finds that the bitumen contains the above properties, it will be safe to say that it will make a good pavement if properly manipulated.

Methods Employed in the Examination of Asphalt Cements—Determination of per cent. bitumen, foreign organic, and inorganic residue. The per cent. bitumen in a substance is determined by extracting it with a solvent, generally carbon di-sulphide. This extraction may be done in various ways. The method that I have found to give the least trouble and require the least experience is by extracting in large test tubes or cylinders and decanting off the solvent containing the dissolved bitumen from the insoluble portions.

The method of procedure is as follows: The asphalt or like substance is spread in a thin layer in a suitable dish (nickle or iron will do) and kept at a temperature of 225 degrees F. until it practically stops losing in weight. The greater part, and, in some cases, all the water and some light oils are expelled in this way. From two to ten grains (depending on its richness in bitumen) of this substance is weighed in a large-size test tube)8 inches long by 1½ inches in diameter) the tare of which has been previously ascertained. The tube containing the substance is then filled to within one and one-half inches of the top with carbon di-sulphide and allowed to stand for a few minutes; then the tube is tightly corked with a good sound cork. It is then shaken vigorously until no asphalt can be seen adhering to the bottom. Care should be taken while shaking to keep one finger on the cork to prevent its being blown out. The tube should then be put away in an up-

right position and not disturbed in the slightest way for two days, after which the carbon di-sulphide is decanted off into a small bottle. As much of the solvent should be poured off as is possible without losing any of the residue. The tube is again filled, shaken as before, and put away for two more days. After the liquid has been carefully decanted the second time the tube with the residue is dried at a low temperature and then at 225 degrees F. After cooling it is weighed. As there is always a small portion of the residue poured off in the solution with the bitumen, this solution must be evaporated and the bitumen burned off in a tarred platinum dish and the weight of the residue added to that in the tube. The weight of the substance taken, less the sum of these two weights, is the weight of the bitumen extracted, from which can be calculated the per cent. bitumen.

The determination of the organic matter, not bitumen, is made by burning, in a tarred platinum crucible, the residue left in the tube after extracting the bitumen. The loss on burning is the organic matter not bitumen, or as it is often called, the foreign organic matter, 100 per cent., less the sum of the foreign organic matter and bitumen per cent., is the inorganic matter.

The softness or consistency of a bitumen or asphalt cement is determined by an apparatus devised by Prof. Bowen, which is generally spoken of as a penetration machine. This piece of apparatus has been described several times in print, and is patented, so I will not enter into any details as to its construction. This determination is made by ascertaining the distance registered in degrees on a dial, that a needle will penetrate into a bitumen in a fixed time and under a fixed weight. The penetration of a sample is taken by lowering the needle until it is just in contact with the surface. A clamp is then released, which allows the needle to penetrate into the sample for any fixed time, one second being the time generally allowed. At the end of this time the clam is closer and the degree of penetration noted from the dial. All samples must be kept at a standard temperature for at least half an hour before making the test. This is most accurately done by keeping the machine and samples in a small room kept at the standard temperature.

Susceptibility to Changes in Temperature—This is determined by taking the penetration of the substance at several different degrees of temperature and noting its variation caused by the rise or fall.

Change Due to Age—All bitumens undergo a more or less rapid change with ageing, that appears to be due to two or possibly more causes. Two distinct changes manifest themselves. One is the surface hardening which is likely due to indirect oxidation and possibly to the volatilization of light oils. It begins at the surface and gradually extends into the bitumen. The other is a hardening of the entire mass evidently due to polymerization. Both these changes take place in all bitumens but one or the other may predominate. The former is much the less objectionable, as it makes but slow progress into the mass. It is preferable that this test be made on the asphalt cement, as there is some danger in using extracted bitumen, of the solvent not having been entirely removed, and its slow evaporation might be interpreted as a true change due to the hardening of the bitumen.

This test is made as follows: The penetration of the sample is determined, after which it is put away for a week, when it is again ascertained. If the sample has been found to have appreciably hardened a slanting cut is made into it with a keen, sharp knife, laying over the upper piece, thus exposing a gradual descent from the surface into the interior of the cement. Penetrations are now taken down the side of this cut, beginning at the surface. In this way the increase in hardness of the surface and the interior over its original consistency is determined; also the hardening of the surface over the interior, and the depth that the surface hardening has entered the sample. It is well to continue this test for as long a period of time as possible, making examinations at intervals of every few weeks.

Its stability upon being kept at a high temperature for a length of time—the necessity of this stability is owing to the length of time the bitumen must remain in a heated condition—during the course of the manufacture of the asphalt mixture, which may cause it to lose valuable properties. The effect of this heat is rendered much more severe on the bitumen, because of its great area exposed to evaporation when mixed with the sand.

The lack of stability resulting from the loss of light oils is manifest in different ways in different bitumens. Although gen-

erally so, it does not of necessity follow that the bitumen losing the most oil undergoes the greatest change in consistency. There are two methods of determining this, but it is advisable to use both. The first consists in making the asphalt cement into a mixture with a standard sand. This is done by mixing sand and the asphalt cement in such proportions that the mixture will contain 10 per cent. of bitumen. This is done by keeping in a hot oven for fifteen minutes at 300 degrees Fahrenheit and then incorporate by stirring the sand and asphalt. One portion of this mixture is then put aside to cool, while the other is kept at the temperature at 300 degrees Fahrenheit for one-half hour longer. The bitumen is then extracted from both and after having arrived at the same temperature their penetrations are compared.

The second method consists in keeping a quantity of the substance equivalent to twenty grams of bitumen at a temperature of 400 degrees Fahrenheit for thorty hours. The method of procedure is as follows: The substance is weighed in a short-necked tubulated two-ounce retort, the tare of which has been previously taken. The retort is then hung in a copper cylinder so that the neck just protrudes. The copper cylinder is jacketed with asbestos and provided with a thermometer. After being heated up to 400 degrees Fahrenheit, at which temperature it is kept for thirty hours, the retort is allowed to cool, then weighed and the per cent. of loss ascertained. The retort is then broken open and the character of its contents compared with that of the original substance.

The action of water and dilute ammonia mixture is determined by molding an inch cube of the mixture under a pressure of 1,000 pounds. The cube is broken in two, a portion being placed in water or dilute ammonia, while the other portion is kept in air. The two pieces are compared from time to time. If it be acted upon by the liquid the corners will be found to give way readily with a slight pressure of the finger. After soaking some time it is well to evaporate the liquid to dryness and note if any bituminous residue remains.

Adhesiveness, Cohesiveness and Elasticity—No method has as yet proved satisfactory for the determination of these, other than the sense of feeling along with experience.

Extraction of Bitumen for the Purpose of Examination—The method which I employ, extraction by subsidation, is the same as employed for the determination of per cent. bitumen, only on a larger scale; and no accurate weighings are necessary. Any method is applicable that will extract all the bitumen in a reasonably pure state. Sufficient of the material to give 20 grams of pure bitumen is put in a large glass cyclinder and extracted with carbon di-sulphide, as before described. The solvent containing the bitumen is evaporated off in a clean metal dish, at a low temperature, until it is quite free from the solvent. It is then heated cautiously to 300 degrees F., at which temperature it is kept for ten minutes. This is necessary, as the last tract of solvent is very hard to remove.

As in the examination of all materials to fulfill certain purposes, some standard must be fixed. In the case of bitumens the knowledge is too limited and the methods too incomplete to fix numerical standards for the various tests; so it is necessary to establish for a standard the bitumen of some well-known asphalt cement. The bitumen generally taken as a standard is that of an asphalt cement composed of the best quality of Trinidad asphalt softened with petroleum residuum.

In the examination of asphalt or like products to determine their suitability for paving, it is necessary that both the hard and softening material be examined, unless the asphalt be already of the right consistency. My method of procedure is as follows:

The materials are mixed together by heating in such proportions as would give a cement of the proper consistency, which is determined by its penetration. All tests are then made on this cement or the bitumen extracted from it; except where the softening agent employed is injurious, when it must be examined and its quantity limited. I refer here especially to petroleum residuum which is used for softening asphalts. I have made a careful study of this and am thoroughly convinced that the use of all petroleum residuums is injurious, some much more so than others. That it is not adaptable, either chemically or physically, to this use, can be readily seen by looking into its properties. With a change of but a few degrees of temperature it passes from a liquid to a solid state. On standing for a month or two a hardening sets in, due either to polymerization or slow crystal-

lization, which makes it even more susceptible to changes in temperature. I am also led to believe, from various experiments, that many asphalts are not entirely soluble in petroleum residuum and for that reason asphalt cement in which it is used is not a chemical, but merely a mechanical mixture of emulsion of the asphalt and the oil. From this it can readily be seen that the undesirable properties of the petroleum residuum are imparted to the asphalt cement to a degree proportional to the quantity of the residuum used. I have found that the best petroleum residuums comply with the following tests:

Specific gravity ranging between 20 degrees and 23 degrees Baume. The flash point (as taken in a New York State Board of Health oil tester) between 300 and 425 degrees Fahrenheit.

On keeping at a temperature of 400 degrees Fahrenheit for thirty hours, as directed in the tests on bitumen, it must lose between 2 and 6 per cent. of oil. The residue in the retort should be fluid at 75 degrees Fahrenheit and on cooling should not show a coarse crystallization. The quantity of residuum necessary to soften the asphalt to a cement, containing bitumen, whose penetration is 80 (District of Columbia standard) should not be over 33 per cent. of the total quantity of bitumen in the asphalt.

It must show only the slightest signs of having been cracked in the course of its manufacture. An oil that has been cracked reveals on being examined through the microscope numerous black particles floating through it. The particles are insoluble in petroleum naptha, but are soluble in carbon di-sulphide and resemble asphaltine.

In the specifications that I now present in this article I have tried to cover all excepting the limestone rock asphalts, which are mostly foreign and are objectionable on account of the poor foothold they afford for horses.

Specifications for Asphalt Wearing Surface—The wearing surface should be made of an asphalt mixture complying with the following specifications. The materials that should be used therefor are:

1. Asphalt cement.
2. Sharp sand.
3. Fine mineral dust.

Asphalt Cement—The asphalt cement must not be inferior in quality to a cement made of the best quality of Trinidad asphalt and petroleum residuum. This bitumen shall comply with the following requirements: It shall be adhesive, cohesive and elastic to a certain degree. It must not show too rapid a change with ageing. It must be practically unaffected by water or dilute ammonia. Its penetration must be within the range of 50 to 120 degrees—(D. C. standard). The petnetration must be governed by the traffic, the range of atmosphere temperature, the susceptibility of the bitumen to change in temperature and the character of the sand. Its consistency should not be greatly altered by change in temperature. Its loss on being kept at 400 degrees Fahrenheit for thirty hours must be less than 8 per cent. and its character must not be so changed that its penetration is reduced to more than one-quarter of its original penetration.

If petroleum residum has been used as the softening agent it must comply with the following requirements:

Specific gravity ranging between 20 and 23 degrees Beaume.

The flash point as taken in a New York State Board of Health oil tester, between 300 degrees and 425 degrees F.

On keeping at a temperature of 400 degrees F. for thirty hours it must lose between 1½ and 5 per cent. of oil. The residue in the retort shall be fluid at 75 degrees F. and on cooling should not show a coarse crystillazation. The quantity of residum necessary to soften the asphalt into a cement, containing bitumen whose penetration is 80 (D. C. standard) should not be over 33 per cent. of the total quantity of bitumen in the asphalt.

Sand—The sand in use should be hard grained and sharp. On sifting it should have at least 15 per cent. of material that would be caught on a 40 mesh per inch sieve, 25 per cent. of material that will pass an 80 mesh per inch sieve, 10 per cent. of which at least must pass a 100 mesh per inch sieve. If the sand to be used does not contain the desired fine material, any mineral dust unaffected by water may be used to make up the deficiency.

The proportions of materials used will depend upon their character and their traffic on the street, but the per centage of bitumen soluble in carbon di-sulphide shall not exceed the limit, 9 to 13 per cent.

In some of the methods of examination I have merely stated the processes that I have found preferable with the apparatus at my disposal.

REPAIRS OF ASPHALT PAVEMENTS.

By E. B. Guthrie, Chief Engineer of Buffalo, N. Y.

Any kind of pavement, when poorly laid, will give its best results when laid on a foundation well drained, compacted and free from underground work. But in a growing city of today the latter presents the most serious problem in maintenance of pavements, by reason of the many trenches for sewers, water pipes and electric conduits of all kinds, whether made by the municipality, the corporation or the individual. Whether these trenches have preceded or succeeded the pavement the evil results are the same, unless great care—and more than is ordinarily bestowed upon them—is given to solidly replacing the earth to prevent settlement. With asphalt, on account of its smooth, flat surface, the results of settlement are much more apparent to the eye than in other classes of pavement, and for this reason we probably are inclined to keep it in a higher state of repair.

From my own experience the conclusion is inevitable that the bulk of asphalt repairs is attributable to settlement over trenches, some to the effect of water getting beneath the roadway and some to errors in surface mixture, which occurred earlier in the experimental period. Classification of repairs might be made as follows, in the order of their magnitude:

First—Improper trenching.
Second—Poor material and workmanship.
Third—Traffic.

Repairs may be classified as follows:

First—Settlement.
Second—Rolls.
Third—Disintegration, where the surface separates into "macaroons" or "nodules."
Fourth—Cracks.
Fifth—Gutter painting.
Sixth—Defects along street railway tracks.

The repairs due to settlement over trenches have been referred to as comprising the majority of all, and covers work done by the various plumbers, corporations, contractors and the city itself. If the defect appears within the period for which the individual or corporation is responsible for its maintenance, they are required to remedy it, otherwise the burden falls upon the city. These repairs are made as occasion requires, to the entire pavement, including concrete, or binder and surface, or surface only.

Rolls or ridges sometimes two or three inches high, and extending frequently from curb to curb, are due, no doubt, to the expansion of the concrete base, though it was a long time before I believed this was the cause. These are sometimes repaired by cutting out the entire pavement and replacing the concrete, which is made of natural cement, by broken stone, and resurfacing; at others by resurfacing only, though I believe the first is the best method, as the roll otherwise is liable to re-occur. We have this year endeavored to avoid this defect by leaving expansion joints in the concrete, extending from curb to curb, and 300 to 500 feet apart, the joints being simply spaces in concrete, in which are placed tar paper, gravel or stone.

Waviness of surface occurs from its movement on concrete by the action of traffic, and where it exists is greatest on that side of the street having the heaviest traffic. This was more frequent before the binder coat of gravel or fine broken stone and asphaltic cement was used. By borings made this season through the asphalt, at some places where this irregularity appeared, the cause was very apparent from the thin coat at the low points and the thick one at the high points.

Disintegration—The breaking up of the surface into small, rounded pieces often occurs through the action of water which has found its way underneath, coming either from adjoining higher land or from the surface through defective places, especially if there is a railroad track in the street. Repair of this class of defect is made in both ways, cutting out down to the base, or simply renewing the top surface, the cementing properties of the asphalt having been destroyed, whatever the cause may be. When repair is made of the surface only the balance of the coating has little more effect than so much sand well compacted, and it is a question if repairs should be made in this way, except on very small patches.

From an examination of streets in 1891, the guarantees of which had almost expired, I made notation of defects, plotted

these, and also the location of sewer, water and gas mains, with the result that most of the defects followed the lines of said mains and their connections. In addition the defects arising from water action generally occurred in places where the soil was clayey, and especially where the abutting land was higher. Since that date we have, where deemed necessary, placed drain tile back of and below the curb to carry off the sub-soil water, and with good results.

Cracks—This class of defects arise, no doubt, mainly from mixtures unsuited to the climate, lacking bitumen and being too brittle, repairs to which are made by running in asphaltic cement.

Repairs Along Street Railway Tracks—The railway company by its franchise is required to repair between its tracks and rails and two feet outside of the rails, though it claims by legislative enactment it was exempted from the latter requirement on our principal business street. Repairs have been made by the city on this street this season which the railway company failed to attend to after notification, and assessment will be levied on the company for the same, with what result is yet to be seen.

The injury to this class of pavement by the street railway company's tracks when not properly laid with tight joints and admitting water will extend, in many cases, to more surface than on any other pavement and far beyond the two feet specified above.

While on the subject I might say I believe the best results will be obtained with a heavy girder rail, rigidly fastened and with longer, heavier connections at switches and turnouts, with concrete under the rails, but not necessarily under the tie, using headers of stone or scoria block, as in Toronto, alternately long and short; if used as stretchers poor results will follow. If the asphalt is carried plumb up to the rail it is impossible to prevent a continuous joint, which will prove injurious. Generally the defects along tracks, laid as they have been in Buffalo, consist of settlement of the rail, leaving the asphalt slightly higher, which then is gradually crumbled off by the traffic; if laid with stone next the rail, but not laid "toothing," a rut is formed between the stone and asphalt to the latter's injury, and if laid "toothing" when the company makes repairs the stone are removed, and with them comes off some of the asphalt. If done without supervision on the part of the city the chances are it will be laid back by cutting a straight joint, filling the space with stone, and this in time is followed by the rut before referred to. This, and the subject of settlement, all point to the conclusion that no individuals or companies should be allowed to disturb the pavement in a municipality except upon special permit for each and every occasion any work is done to disturb it, and, further, in my judgment, that the repairs to a pavement required by such work should be done by the municipal authorities and paid for by the individual or corporation.

Gutter Painting.—The gutters are the weakest part of an asphalt pavement on account of the action of water, and extensive repairs are made, either by cutting out the asphalt when deteriorated to the extent warranting this, or by smoothing the surface and covering anew with asphalt richer in bitumen than the remainder of the surface. I am of the opinion that gutters and curbs made of concrete would be an improvement on those ordinarily made, and I hope to learn from other cities their experience with this class of gutters.

Repairs have been made in Buffalo by contracts, each covering a period of one year, those of the current year being upon specification. It is essential that repairs be made soon after a defect appears to prevent its increase. When binder is used the stone forming the same and the surface of concrete should be clean and free from moisture, and in cuts all edges should be well covered with asphaltic cement to insure a perfect joint, and the material thoroughly rolled, being left slightly full that a depression may not result. It is our practice to locate and plot all repairs to avoid overlapping, and see that none are paid for which the contractor is obligated to maintain under the three years' guarantee. Though this is quite a complex system, there is no other way to locate responsibility, unless a contract is made based on a certain price per square yard of all under city maintenance, or for the city to have its own repair plant, which latter course will probably be the result in cities having large areas of this class of pavement.

The greater proportion of repairs are made by the "skimming" process, in which is used either a heater such as the "Perkins," having a tank of fuel oil and hooded burners, or an open grate on low wheels, in which coke is burned, heating the surface so that it can be raked off,

smoothed down if too high, and filled up if too low, in each case with the addition of some new material. It has been the custom to permit the use of old material for repairs, the same being heated, new asphalt added thereto, provided the old material has not been injured by heat, though it is questionable whether or not new material should not be required.

The first asphalt pavement laid in Buffalo, other than a small experimental piece at a street intersection, was on Delaware-ave., in 1878, for a distance of 1,990 feet and covering 9,286 square yards. This was laid by the Columbus Paving Company under the management of Mr. N. B. Abbott. It had a broken stone base 8 inches thick, covered with coal tar pitch, upon which was a binder course 3 inches thick of sand, gravel and coal tar pitch, then a 2-inch surface of Trinidad asphalt, sand and wax tailings. This street was resurfaced before the expiration of the guarantee, was repaired by the property-owners about 1890, and was resurfaced in 1892.

Franklin street was laid in 1879 by the Buffalo-Abbott Paving Company for a distance of about 2,043 feet, covering 7,264 square yards, and similar in character to the preceding, except that the stone base was 6 inches thick, and coarser sand and limestone was used in the surface. This street, in the eleven years of city maintenance, has been repaired to the extent of $2,827.82, equal to $.035 per square yard per annum, and in a year of two will probably require resurfacing. It has been subjected to a large amount of light traffic, and, being an old residential street, has not been torn up so much for underground work, as many others, and presents the best example of a street worn mainly by traffic.

The growth of this class of pavements in Buffalo has been such that there were on Jan. 1, 1896, the following quantities and repairs for 1895 and the eleven years of city maintenance, 1885 to 1895, inclusive, were made to the extent shown:

Jan. 1, 1896.—

Miles of asphalt, exclusive of parkways	192.9
Total yards laid	3,581.238
Total squares laid under guarantee	2,123,168
Total yards maintained by city	1,384,418
Total square yards maintained by street railroad	73,652
Total first cost of pavement	$10,636,157.92

Construction, 1896, to Oct. 1.—

Miles	5.22
Square yards	89,163
Cost	$261,360

Prices paid for repairing asphalt pavements:

REPAIRS.

	Total Cost of.	*Maintained by City, Sq. Yds.*	*Cost, per Yd.*	*On Streets Repaired, Sq. Yds.*	*Cost, per Yd.*	*Actually Repaired, Sq. Yds.*	*Cost, per Yd.*
1895	$69,661.49	1,042,543	.067	795,313	.087	57,068	1.22
1885 to 1895 inclusive.	184,349.09	*3,339,558	.055	*2,325,239	.079	134,827	1.37

* These are in equivalent yards per annum.

REPAIRS 1885–1895, INCLUSIVE.

At Periods 1 to 11 Years After Expiration of Guarantee.

Period.	*No. of Streets.*		*On Streets Repaired.*		*On Total Maintenance.*	
	Paved.	*Repair'd.*	*Square Yards.*	*Cost, per Yd.*	*Square Yards.*	*Cost, per Yd.*
1 Year.	132	44	528,923	.035	1,057,025	.018
2 Years.	92	56	587,267	.086	807,692	.062
3 "	73	56	503,730	.085	606,024	.071
4 "	51	37	329,218	.136	403,550	.108
5 "	24	17	145,591	.114	200,179	.083
6 "	9	6	54,400	.063	89,761	.038
7 "	9	8	88,779	.057	89,761	.056
8 "	6	5	44,660	.034	53,946	.028
9 "	3	2	16,140	.019	28,445	.011
10 "	2	2	10,283	.061	10,283	.061
11 "	1	1	7,264	.046	7,264	.046
Average per yard per annum				.079		.055

Prices Paid for Repairing Asphalt Pavements.

	1891.	*1892.*	*1893.*	*1894.*	*1895.*	*1896.*
Resurfacing, per square yard...	1.29	1.62	1.59	1.54	1.49	1.35
Skimming.....	....	....	....	....	.99	.88
Replacing base and surface...	2.35	2.47	2.44	2.39	2.37	2.25
Scraping joints and painting gutters, per lin. foot.....	.04	.04	.04	.04	.04	.03½
Cleaning and pouring cracks per lin. foot...		.02	.02	.02	.02	.02
Replacing stone toothing along street railway tracks, per lin. foot.....	....	....	....	....	.19	.17

While the streets have been under the charge of contractors, the guarantee having been uniformly five years, except on streets paved in 1884, where it was extended to eight years, repairs have mainly been attended to where and to such extent as they were found necessary without necessity of demand from authorities. This is not the proper way, for the authorities are not enabled to study each pavement and get data for avoiding similar defects.

Upon the expiration of the guarantee the streets are placed in thorough repair under supervision of inspectors, in some cases to the extent of resurfacing the entire street. The maintenance guarantee, as ordinarily drawn, is not specific enough, leaving too much to the discretion of the authorities, and I believe it should be for a longer time, state as closely as possible what kind and to what extent repairs should be made by patches, filling, skimming, or when to be resurfaced.

Furthermore, an inspector should be placed at the plant of the paving contractor to know what course is pursued there, otherwise the municipality has no data for study of various mixtures, nor does it know that the contractor is carrying out the specifications in this important feature.

MODERN STREET RAILWAY TRACK CONSTRUCTION ON ASPHALT PAVED STREETS.

By F. W. Cappelen, City Engineer of Minneapolis, Minn.

The traveling public today is very much more extravagant in its demand for comfort, and we might say luxuries, than it was a few years ago. This refers not alone to the equipment of a railroad, but also to the roadbed and track, and it is a common remark to hear that such and such a road is preferred to any other because of its easy track and well maintained roadbed. This is as it ought to be. Upon the condition of the track depends the successful operation of the road to a large extent; also the life of the rolling stock and the safety of life and goods transported by the railway company.

As an illustration of the demand for first-class equipment, the writer is reminded of an incident that occurred in Minneapolis during this season's fall festivities. A great many floats participated in a magnificent parade one evening, and amongst them appeared (placed upon a small truck) a little 2x4 street car for one mule, labeled with a large sign thus:

"We rode in this in '74 and were happy."

Immediately behind this came a beautiful, latest improved, electric car, with this:

"We ride in this today and kick."

On ordinary railroads the entire track is, practically, constantly patroled, so that bed and track can be kept in as good condition as the management desires. Low joints are readily raised, bad ties easily exchanged for good one, bolts tightened, etc., as everything is in plain view to the men in charge. The conditions are entirely different on a street railway.

After the track is down nothing is visible but the top or running surface of the rail; and when a joint sags it means the ripping up of the pavement of the street at that point to do the required work of putting the track in proper alignment and to proper grade. The same is the case when removal of ties or rails becomes necessary. In addition to the cost of properly caring for the track itself comes the cost of repairing the pavement between the tracks, it being taken here for granted that the corporation owning the street railway will at least care and pay for the pavement in the space from outside to outside rail on a double track road. The repair bills in a street railway system operated with horses were comparatively small, although the track construction generally was poor. The cable

roads made far better track construction an absolute necessity and companies that attempted and are attempting light and poor track construction for electric street railways have found or will find that the expense for maintenance of track is a big item.

The ordinary horse car weighs about 11,000 pounds, the cable car 12,000 pounds and the electric car from 19,500 to 43,000 pounds. These figures speak for themselves. The city of Minneapolis was one of the first in the United States to change its horse railway system into an electric system and made the entire change of 100 miles in one year.

The company, however, did not change track and rail very much, but used a great amount of four-inch light rail—forty-five pounds and fifty-four pounds per yard. The Johnston seventy-eight-pound girder rail was also used and, after considerable wrangling, the city council permitted the company to use the Shanghai six-inch seventy-pound T rail on some new extensions.

As most of the streets were paved with six-inch cedar block on two-inch foundation plank a great deal of trouble was experienced with the pavement next to the rails and between them.

The ties had to be cut down or four-inch blocks were used with the six-inch "T" rail strips of wood were placed along the rail to form the groove for the flanges of the car wheels to run in. The rails were spiked to pine ties on two feet centers and most anything used for ballast.

In a good many cases cobblestones were used between the rails. The city charter, however, provides that the space between rails must be paved with the same material as the balance of the street, but the City Council would occasionally grant the company the right to do differently. After awhile asphalt was ordered on certain streets and the street railway company was obliged to look at the matter of track construction in a different way, but finally got permission to pave between rails and tracks with granite and the city put granite toothing on the outside of the rail. The six-inch seventy-eight-pound Johnston girder rail was used, but no particular care was taken in the ballasting of the tracks and the result was, of course, that it settled and the asphalt broke away after a short period.

This year several principal down-town streets were ordered paved, and the writer was delighted to learn that the street railway company would do everything in its power to construct a first-class track in every respect.

For all crossings and curve work, the so-called Johnson (Pa.) guaranty work was used. All switches and frogs have removable Harveyized steel pieces, and it is expected that this work will stand in the worst places at least nine years. The life of the old frogs, etc., did not exceed five years, and they were generally pretty bad after two years' wear.

Ties were used for this part of the track and they were set in concrete and the entire intersection and cross-overs were paved with fine cut granite set in cement mortar and the joints were filled with cement.

For all straight track work, 60 feet long, "T" rails were used. The rail is the American Society, 80 pounds, five-inch base by five inches high, standard. Three methods of constructing the track were used.

The same company owns the street railway system, both in Minneapolis and St. Paul, and work was commenced in St. Paul somewhat earlier than in Minneapolis. The first plan was used there in the following manner: After the sub-foundation had been thoroughly rammed or rolled the necessary slight excavation was made for a concrete beam to run longitudinally under the rail. This beam was eight inches in depth and fifteen inches wide, and constructed so that the top surface would be at the proper grade to receive the base of the rail. This beam was formed between boards. The concrete used consisted of one part Empire Portland cement, two and one-half parts of sand and four and one-half parts crushed rock. Upon the beams, after they had set, the rails were placed and tied together every ten feet with 2x⅜ tie-rods set on edge.

After the rails were lined up the joints were welded, room being left in the concrete every sixty feet for the joints. The street railway company experimented last winter with the so-called Falk cast welded joints and adopted them for all future work. The joint is made in the following manner: The rails where the joint is to be made are first thoroughly cleaned with files and emery paper, cast-iron molds are then placed around the joint, held in place with clamp screws, both horizontally and vertically. It was found necessary to have a very heavy vertical screw to prevent the joint from heaving on account of expansion due to the heat developed.

After the molds were placed the molten metal was poured and the joints completed. After cooling the molds were removed and any rough edges left were trimmed off. The joint is made so that a flange way is formed in the cast. The company owns two of the so-called cast welding machines made by the Falk Manufacturing Company of Milwaukee, Wis. The cost of the machine is about $2,500 and the capacity 8,500 pounds per cast. The joint for the eighty-pound rail requires about 138½ pounds of metal and the cost per joint is about $2. This includes the cost of fixing the rails for the joint. A forty-five-pound rail requires 102 pounds for a joint and a fifty-four-pound rail requires 115 pounds for a joint. A mixture of half pig and half casting scraps gives the best results. The furnace is loaded in layers, beginning with wood, coke and pig, coke pig, etc.

After the joints were made Milwaukee cement concrete, six inches in thickness, composed of one part of cement to two and one-half parts of sand and four and one-half to five parts of rock, was placed to proper grade to receive two and a half inches of asphalt pavement across the entire street and between rails and tracks, leaving enough space on the inside of the rails to place along the same granite blocks four and a half inches deep, three and a half inches wide and nine inches long.

These blocks were, however, set simultaneously with and in the concrete, being separated from the head of the rail by a one and a fourth-inch wooden strip, so as to form the flange way for the car wheels. After the strip was removed the lower two and a half inches of the space left was filled with cement grout and the upper two and a half inches to the top of the rail was filled with asphaltic cement, consisting of about 30 per cent. asphalt and the balance lime stone dust.

This mixture remains soft enough to form the proper groove when the first car is run over the track. The joints between the granite blocks were filled with asphaltic cement.

After the track work was completed as described the asphalt pavement proper was put down flush to the top of the rails everywhere, but where the groove was.

Considerable trouble was experienced in St. Paul with the rails after the joints had been cast. In a little while about 1,500 feet of track looked like a snake and it was very difficult to get the track back in line; in fact, the superintendent of the street railway company thought he would be obliged to cut the rails, but he got along without doing so. When the work came up in Minneapolis, this matter was discussed and it was thought advisable to proceed in a different way.

Ties were placed about every six feet to eight feet apart, and the rails were lined up and temporarily fastened to the ties; then the castiron joints were made, and the concrete beam put in between ties in the same manner as in the first case. The ties were then pulled out, the space filled, and the balance of the street concreted and completed as before.

The rails were also spiked to the concrete beam as soon as it was in place. The track was kept in perfect alignment this way. After further discusssing the work as it progressed, a further modification in constructing the beam was adopted. As it was not always possible to follow up with the concrete work of the street proper as fast as the beam was built, a good bond was not obtained between the beam and the other concrete, so the method was changed this way. The ordinary concrete was put down outside and inside the rails, forming a rough groove about eight inches deep, fifteen inches wide at the bottom and eighteen to twenty inches at the top.

In this groove, as soon as it was built, the beam concrete was placed; otherwise the construction was as in the second case.

The cost per foot of rail for the beam construction, only including grading for the same, was in the first case 26 cents, in the second case 26 cents and in the third case 27 cents. The filler cost about 5 cents per foot.

The cost of putting down temporary ties and laying, lining and surfacing one mile of single track preparatory to putting in concrete beams, and including labor and material used in welding the joints was (approximately) $850.

In connection with this change of track construction the writer changed the cross sections of the streets as well as the intersections, where repaving was done. All the old streets have very deep gutters, from twelve to fifteen inches, and even more. This made it necessary at intersections to use bridges over the gutters at the corners, making them unsightly in the first place and generally the gutters were easily filled under the bridges, and finally too much space of the street was lost.

Wherever repaving has been done this was changed, so that now the gutters are only six to eight inches in depth, with corners of the streets rounded off to twelve-foot radius and the street raised at the corner so that only a step to the pavement of from four to five inches is needed.

Drainage is taken care of by putting in double catch basins. This makes beautiful intersections and pleases everybody.

On a fifty-foot roadway paved with asphalt and without tracks eight-inch gutters and ten-inch crowns are used; with tracks eight-inch gutters and seven-inch crown from rail; on streets before changed fifteen-inch gutter and twelve-inch crown.

The cost per mile of a double-track constructed as described would be about:

Cost of putting down temporary ties and laying, lining, surfacing, joints, etc., of double track.	$ 1,700 00
Beam work, etc	6,968 00
*Rails and tie bars	9,400 00
Asphalt paving at $2.43 per square yard, ten-year guaranty	15,840 00
Total per mile	$33,908 00

This is a very heavy expense and it is sincerely hoped that the construction will prove satisfactory.

About two and a half miles have been completed this season in Minneapolis.

As far as the writer knows the construction has only been used in Montreal, Toronto, and perhaps Detroit. In the two Canadian cities the cast welded joint was not used. The writer would suggest that a different T rail be used, viz.: a rail six inches high, with a six-inch base. The four and a half-inch granite blocks ought to be five and a half inches deep and the six-inch base would give a better bearing on the concrete beam.

It may be of interest to know that the Warren-Scharf Asphalt Paving Company claims a patent on the method of forming the asphaltic flange way before referred to. This company did all the paving on streets with car tracks and E. M. Ayers, using Utah lime rock asphalt, laid all streets without tracks.

*Sixty-foot rails cost $2 a ton more than thirty-foot rails.

TESTING PAVING BRICK.

By A. D. Thompson, City Engineer of Peoria, Ill.

The rapid increase in the use of brick for paving purposes has directed the attention of officials in charge of such work to the best methods of procuring the most durable material at a reasonable cost. Municipal officers agree that the three essential qualities to be possessed by paving brick are as follows:

1. It shall be tough, to prevent rapid wear, thus prohibiting brittleness or undue softness.

2. It shall be non-absorptive, to prevent disintegration by the weather and the absorption and retention of street fluids, which produce an unsanitary pavement.

3. It shall have sufficient strength to resist, without crushing or breaking, the heaviest loads passing over the street.

The old plan universally employed was to judge paving brick by inspection, and fully one-half the cities using brick pavements at present require brick satisfactory to the engineer or Board of Public Works, without naming definite qualities. This is unfair to the manufacturers, as well as to the citizens paying heavy assessments for street improvements, and is the main reason for condemning brick pavements.

Color is used by inspectors as the main guide to judge the quality, and it is a good basis to compare bricks from a single factory after determining by tests the color indicating the best quality, but it cannot be used in comparing the qualities of bricks manufactured at different places. The various materials used—clay, shale, fire clay, or mixtures of these; the method of manufacture and fuel used in burning—coal, oil or wood—all affect the appearance and color of a brick and render it impossible to use the same color as a criterion by which to judge the bricks of different manufacture. The bricks manufactured at two places in Illinois are made from a shale which is supposed to be the same. The black bricks from one are the best, but the same color from the other factory indicates a brick that is unfit for use. Another factory used coal as a fuel for the first portion of the present season, and the black brick, while most acceptable under this condition, were re-

jected when the fuel was changed to oil.

Another strong point in favor of testing brick and inserting test requirements in the specifications is that by this means only is it possible to state the specific qualities which the material demanded must fulfil. Engineers draw up these specifications as a rule, and the unprofessional method of requiring any material satisfactory to any man or set of men should be strongly condemned. It is acknowledged by engineers that the fairest competition and the best quality of materials can be obtained for all construction work by making the requirements for the same specific and definite. It is only by test requirements that the qualities of a paving brick can be accurately defined. Again, a continual demand for a better quality of brick, which reliable experiments indicate can be obtained, forces the manufacturer to supply the demand by raising the standard of his product.

The points which appear to establish the necessity of testing paving brick are:

1. There is no other method of determining the quality.

2. It is the only method by which the qualities demanded can be definitely and specifically stated.

3. It is the only method of judging quality which is fair to both the manufacturer and citizens.

4. The quality of the material is continually improved.

It is claimed by many engineers that the fitness of a brick for paving purposes can only be determined by submitting it to actual wear in the street, and that no system of testing has been devised which will determine whether a brick possesses the qualities necessary for a good paving material. Even among the men who admit the necessity and appreciate the value of tests there is a wide difference of opinion as to those which are necessary and the methods of conducting the same.

The amount of absorption in a specified time is used by some cities as the single criterion of the quality of a brick, while among the tests required by other municipalities are those for absorption, abrasion, impact, grinding, penetration by oil, transverse strength, crushing strength and chemical analysis. There are but three qualities to be determined, viz., toughness, non-absorptiveness and strength, and the three mechanical tests of abrasion, absorption and transverse strength show conclusively the degree in which these qualities are possessed by the specimen, thus making additional tests superfluous. The chemical analysis of brick and penetration by oil give no data as to its wearing qualities, although the first test of the clay or shale is valuable in determining its fitness for the manufacture of brick. It is not necessary to determine the crushing strength, because a brick which possesses the requisite transverse strength is sufficiently strong to resist crushing.

The quantity of water absorbed in a given time indicates the probable disintegration by freezing, and is also an indication of the completeness of vitrification. Since the material is hard and

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dense the brick should be immersed for a time sufficient to permit the water to reach the center, but this should not be unnecessarily extended, as every day used in conducting tests may cause considerable loss to the contractor or manufacturer. There have not been sufficient experiments conducted to definitely establish the minimum time necessary for this test, the time usually specified varying from two hours to seven days. From experiments and observations in the past three years the writer has found that paving brick absorb the larger part of the water in forty-eight hours, after which the absorption is very slow, thus indicating that water reaches the center of the most dense brick in the first named time.

The bricks should be thoroughly dry before immersion, which condition can be attained by drying in a gas oven. They should also be broken, or the outer coating removed in some manner, as it is non-absorptive and seriously interferes with the absorption in most cases.

To determine the effect of the outside coating on ordinary paving brick, which were not salt glazed, several lots were thoroughly dried and immersed in water, without breaking them or removing the coating. The amount of absorption in forty-eight hours was noted with the bricks in this condition. They were then broken in the middle and again immersed for the same period of time, with the following results:

	Per cent. Absorption.		Average Gain.
	Before Breaking.	After Breaking.	Per cent.
Lot No. 1, average of 27 samples	1.49	3.72	2.23
Lot No. 2, average of 14 samples	5 84	6 05	0 21
Lot No. 3, average of 20 samples	1 38	1.70	0.32
Lot No. 4, average of 7 samples	3.32	3.33	0.01
Lot No. 5, average of 11 samples	4.59	4.67	0 08
Lot No. 6, average of 4 samples	5.67	6.01	0.34
Lot No. 7, average of 13 samples	3.59	3.88	0.29
Lot No. 8, average of 12 samples	5.11	5 31	0 20

Each lot of brick was obtained from a different factory.

This coating is the most impervious on the very hard-burned brick, but as the interior of these is generally non-absorptive, the effect of the coating is most noticeable on the medium-burned, with a hard coating and a softer interior, there being practically no coating on the very soft ones.

The amount of absorption allowable depends largely upon the material from which the brick is manufactured. In the winter of 1894-5 the writer conducted some experiments to determine this point, using bricks in each lot of varying degrees of hardness, from those which absorbed nothing to bricks which absorbed 10 and 12 per cent. in forty-eight hours. Lots were procured from two factories producing shale brick. After immersion in water for forty-eight hours they were placed in a brewery brine tank until thoroughly frozen. They were then thawed, dried and weighed, and this process repeated fourteen times. The tests were stopped at this point by an inquisitive genius, who obtained access to the laboratory and broke large pieces from all the bricks in sight to examine the interior. These experiments, however, indicated that with shale brick an absorption of from 5 to 6 per cent. in forty-eight hours could be allowed, with no resulting harmful effects from the frost, and considering the absorption test merely an indication of the action of the frost, the requirements of the different municipalities are generally too severe. This conclusion was corroborated the next winter, when the same experiments were conducted upon lots from seven factories. In this case the bricks were immersed in a shallow pan of water and frozen five times by exposing them to the weather.

But this test is of more value as an indication of the vitrification, or the point just previous thereto, which is an absolute requirement for good paving brick. This quality is shown by no other test thus far devised, and a brick which absorbs more than 2 to 2½ per cent. of the water in forty-eight hours lacks this element to such an extent that it will not produce the best results in a pavement.

The transverse test gives the strength of the brick when used as a beam, with the load applied at the middle, and is valuable in determining brittleness and showing laminations. A high transverse strength is also an assurance of high crushing strength. For reasons this test is of more value than is generally accorded it. It is made by supporting the bricks at the ends upon knife edges and breaking them by pressure applied by knife edge at the middle, with bricks laid flat. The strength per square inch of section is then figured by the beam formula: $R = (3\,l \div 2\,bd^2)\,w$, where R— modulus of rupture per square inch, l- length in inches between supports, b- breadth in inches, d- depth in inches, and w- loads in pounds. The highest modulus required three years since was 1,600 pounds, but this requirement has steadily increased until the past season the writer has required a modulus of 2,200 pounds, and has obtained extremes of 5,800 and 6,000 pounds, while moduli of 3,800 and 4,000 pounds have not been uncommon. These results were obtained without grinding the surface to parallel

planes or placing on them anything to equalize the pressure.

The toughness is generally determined by the abrasion test, which generally consists in tumbling a number of bricks in a foundry rattler for a certain length of time, together with given quantities of scrap iron or other substances of various sizes or weights. This treatment is intended to produce the same effect upon a brick as the blows of horses' shoes, which is the main cause of wearing on brick pavements, and it is preferred to the grinding test, because it is less difficult to conduct and more nearly represents the actual wear on the street. A test conducted in this manner is the best that has been devised for such a purpose, but it is far from satisfactory, because of the uncertainties attending the results obtained at different places. The size, shape and speed of the rattler, the size, quantity, kind and weight of the scrap iron or other material used, and the number of bricks tested at one time, are all factors determining the toughness of a brick, which vary with every engineer. The rattler should be of a sufficient size to tumble the bricks and allow a reasonable fall. Experiments conducted by Prof. A. N. Talbot at the University of Illinois and Mr. H. J. Burt to determine the effect of size of rattler upon the abrasion test, tend to show that, "for lengths sufficient to prevent the wedging of bricks at the end, say 20 inches, there is no great variation in results, the relative number of brick and proportion of volume of rattler filled remaining the same." Also that "a rattler 24 inches in diameter gives greater wear than one of small dimensions, and there is probably little difference between one 24 and one 30 inches in diameter."

Prof. Orton of the Ohio State University, in reporting the results of tests to the National Brick Manufacturers' Association, conducted to determine the effect of length and diameter of rattler, says: "The length of the cylinder was varied from twelve inches up to forty-eight inches by the use of the movable diaphgram. The shortest cylinder, 12x28, say, give less regular results than those which were longer, because of the tendency of the brick to wedge endwise. But from eighteen up to forty-eight inches in length (the diameter being always constant) the wear was substantially uniform for all sides, showing that if the percentage of volume of the charge, and the time and the speed be maintained equal, that length cuts no figure." As the results of his experiments to determine the diameter producing the abrasion Prof. Orton concluded that, all other conditions remaining uniform, the loss varies directly as the diameter up to a certain point, and that above a diameter of twenty-eight inches there is no increase in rate of loss.

The abrasion is also affected by the shape of the rattler, which is generally circular or hexagonal. The interior of the circular iron rattler is soon worn so smooth that instead of tumbling the bricks merely slide around, and it is best to fasten three or four narrow wrought iron strips on the inside to prevent such action. The abrasion is less in wooden rattlers than in cast-iron, because the wood acts as a cushion in breaking the fall of the brick.

The amount of abrasion with a given number of revolutions depends to a great extent upon the rapidity. If the rattler be revolved at a very high speed the effect produced upon the samples is slight.

Experiments conducted by the writer, and corroborated by results obtained by Prof. Talbot, indicate that the maximum loss appears to be obtained at a speed between twenty and thirty revolutions per minute.

Scrap iron is generally used for the abrading material, because of its cheapness, but the size, kind and quantity to be placed in the rattler varies widely. The size should be such that not only a grinding effect is produced, but the bricks should receive blows at each revolution which will be similar to the blows received in the pavement. Many engineers advocate using foundry shot or stars, which produce a grinding effect only, but the main objection to the use of small pieces alone is that the brittleness of a brick is not discovered. The abrasion test, using foundry shot for the abrading material, is no measure of the toughness, as brittle bricks under such conditions give the highest results, unless this fault is shown by the pounding of the other samples. Brittleness is the most serious fault of paving brick today, and it must be overcome before brick can compete with other paving materials for streets of heavy traffic.

The grinding and pounding effect can both be obtained by using scrap iron of various weights, say from one-fourth of

a pound to five pounds, with a certain per cent. of pieces of intermediate weight. Pieces larger than about five pounds in weight break many of the bricks. In order to make the tests uniform the scrap iron should be revolved until the sharp edges are worn off and the same point observed as new iron is added. The quantity of scrap iron that should be used and the number of brick tested at one time depend upon the size of the rattler. There should be sufficient scrap iron to fill the rattler the full length for a depth equal to about one-sixth its diameter.

The size of the rattler and quantity of abrading material used determines the number of bricks it is best to test at one time. A sufficient number should be placed in the rattler to eliminate accidental loss, as nearly as possible, but it must be borne in mind that too great a number will cause a large breakage of the samples. With a rattler two feet in diameter and three feet long, with 300 pounds of scrap iron, the writer has found twelve bricks a good number. The number it is safe to use can readily be determined in each case by a few experiments, maintaining the same conditions and noting the effect of varying number of samples.

The experiments conducted by Mr. H. J. Burt and Prof. Talbot, previously referred to, give some interesting data regarding the size and amount of scrap iron producing the greatest abrasion. Regarding these tests, Prof. Talbot in a personal letter, says:

"The tests were made with shot of two different sizes, the larer size 2½x3⅛x5¼ in., with corners rounded with ½ in. radius and weighing about eight pounds each, and the smallest size 1x1½x2½ in. with rounded corners, weighing about one pound each. In some of the experiments ordinary foundry shot was also used. With one pound shot charges of 100 pounds to 400 pounds gave nearly equal losses, while 200 pounds gave a greater loss. With eight pound shot the larger the charge the greater the loss, 400 pounds being the greatest amount used. With a mixture of 100 pounds of one pound and 200 pounds of eight pound shot the loss was 40 per cent. greater than with 200 pounds of one pound and 100 pounds of eight pound shot. The action in the two cases is quite different. With eight pound shot there is considerable spalling and chipping, while with one pound shot the abrasive action was the principal one."

"The use of brick alone, without foundry shot, which has been recommended by some experimenters, was not considered desirable, because the loss varied so much with charges composed of different numbers of the same kind of brick, and the size of the brick also had an unknown effect, and likewise there was some chance of accidental and unusual loss to individual bricks. To avoid these, it seemed to me necessary to use as many as twenty-four brick, a very cumbersome test."

This test should be conducted a sufficient time to produce an appreciable loss and develop the faults of the bricks. The duration of the test should be governed by the amount of iron used in the rattler and the number of revolutions per minute. During the season of 1894 the following tests were made by the writer to determine the limit of time for the abrasion test. Bricks of different manufacture were obtained and each lot was revolved for four consecutive hours, the loss being noted at the end of each hour, and expressed in terms of the weight at the beginning of each hour, all conditions of the test remaining the same for each lot. The following results were obtained, which are the averages:

Lot.	*Per Cent. Loss.*				
	1st Hour.	*2d Hour.*	*3d Hour.*	*4th Hour.*	*Total.*
1	8.35	6.79	5.47	3.99	21.4
2	11.44	6.81	3.55	5.04	22.3
3	11.07	5.09	4.40	3.43	22.5
4	9.28	5.09	3.31	2.11	18.2
5	12.59	6.67	6.21	4.12	26.4
6	9.40	4.00	4.08	3.61	19.7
7	9.45	4.52	4.59	3.14	20.0
8	7.92	4.74	3.59	2.24	17.4
9	6.59	2.32	2.54	2.00	12.9
10	11.16	5.55	4.00	2.97	21.8
11	7.11	4.07	3.79	2.58	16.75
12	7.99	4.81	3.17	2.64	17.62
13	6.52	4.07	4.66	4.33	18.29

These experiments showed that under the conditions imposed one hour produced an appreciable loss upon the best paving brick, and that the loss gradually decreased. For this reason one hour was adopted as the limit for the abrasion test. The conditions under which the tests were conducted are as follows:

Circular cast iron rattler, two feet in diameter, three feet long, and containing 200 pounds of scrap iron, weighing from one-fourth of a pound to five pounds.

The rattler was revolved at the rate of fifteen revolutions per minute for one hour; shaft does not extend through rattler; not more than twelve bricks 2½x 4x8 inches in size being tested at one time.

The abrasion test has since been conducted in the same manner, except that during last season four wrought iron strips one inch by one-half inch, equally spaced, were bolted to the inside of the rattler to prevent sliding, and the amount of each size of scrap iron has been used in the following proportions:

Fifty pounds of each of the following weights:

¼ lb. to ½ lb.	½ lb. to 1 lb.
1 lb. to 2 lb.	2 lb. to 3 lb.
3 lb. to 4 lb.	4 lb. to 5 lb.

The custom of comparing the loss by abrasion with the loss on some some other substance subjected to the same treatment gives unreliable results. The substances generally chosen are cast iron or granite of the same size as the bricks. The comparison with Quincy granite, as proposed by Prof. Baker of the University of Illinois, appears to be especially faulty.

In the first abrasion test conducted the writer attempted to compare the loss of the bricks with that of Quincy granite cubes subjected to the same treatment. For this purpose granite cubes were procured from Vermont, and were received with rough edges. No marble yard in the city could dress them, and the experiments were conducted with the cubes in that condition. These experiments soon developed the fact that the cubes varied in hardness, and the loss of the lot was not regular, being much less after the rough edges were worn off. The plan was then adopted of obtaining the loss in per cent. of the original weight, and this method has been perfectly satisfactory.

The lack of uniformity in the requirements by different municipalities of the kind of tests, manner of conducting same and results desired, has caused much dissatisfaction among engineers and manufacturers, and has made brick tests of no value except for local comparative purposes. Engineers, municipal officers, manufacturers and citizens will not place confidence in such results until a standard of the tests required and manner of conducting them is adopted by the several cities interested.

PAVING STREETS WITH BRICK.

By S. J. Hathaway, Chairman of Street Committee, Marietta, Ohio.

The streets of Marietta are quite wide, most of them being eighty-three feet wide. Two are 115 feet and one 150 feet in width. This last was named for Gen. Washington by the early settlers, many of whom had served in the continental army, and so named the broadest street for Washington. The Ohio company which founded Marietta was formed in Boston at the Bunch of Grapes tavern, March 1, 1786, and, having the narrow streets and cow paths of Boston before them as object lessons, they resolved that the new city they were about to found at the mouth of the Muskingum should have amply wide streets. We have good wide streets, but it costs a great deal to improve them, owing to their extra width, yet we are thanking those wise associates of the Ohio company more and more as time goes on for giving us such broad thoroughfares. "They builded better than they knew."

On the main business streets we pave fifty feet in width; on other streets forty feet. One street has been paved twenty-four feet in width, but there has been complaint about it being so narrow. Teams cannot turn round easily on such a narrow pavement.

The contractor excavates one foot in depth the full width. The sub-grade is then rolled with a heavy road roller. Our specifications call for a seven-ton roller, but on Third street—the one now under contract—we are using a thirteen-ton roller, thereby securing a much better foundation. After the steam roller gets through with a square, the bicycle riders can ride over the grade with as much ease as they can over a paved sidewalk. After the sub-grade is rolled six inches of gravel is put on, then rolled with a seven-ton roller, the steam roller being too heavy for rolling gravel. Then two inches of sharp sand is put on to lay the brick in; then six inches of gravel, two inches of sand and four inches of brick, making in all twelve inches. This fills the excavation back to the established grade. Then one inch of sand is spread on the top and broomed in and the brick are

rolled with a seven-ton roller. After that one inch of sand is spread over the surface and the pavement is finished.

We use Berea curb, five inches thick, eighteen to twenty inches wide, with none of the pieces less than four feet long.

The crown of the pavement is usually even with the top of the curb, with six inches depth of gutter. The hight of the center is generally equal to hight of curb.

The engineer always runs in two lines, one for each curb, as sometimes the curbs will vary a little in hight to accommodate varying conditions on the sides.

The curb is set in a sand cushion, two inches deep and is backed by two inches of sand thoroughly tamped. We have never had any trouble from frost, and we have not found a better stone to wear

S. J. HATHWAY.

than Berea, but any hard stone will do just as well if it can be got out in proper lengths.

The two principal points, of course, in a brick street pavement are, first, the foundation; second, quality of brick.

Many different kinds of brick are offered. Two kinds, however, present marked differences—shale and fire clay. Both of these kinds are known to the trade in two general divisions—standard brick and repressed brick or block. A repressed paving brick is generally larger than a common or standard brick, and is called a block. It makes little difference, in my estimation, which you use, provided they are equally well burned. One-third fire clay and two-thirds shale makes a fine hard brick. There may be other combinations, but I am only familiar with this one. We have more streets paved with this than any other kind. We also have several streets paved with Hallwood block, which are giving excellent satisfaction. One street subject to heavy traffic was paved with this block three years ago and you can scarcely find a block which shows signs of wear so far.

On the whole, I am in favor of a repressed shale block and believe if it had one-third fire clay it would be an advantage. I live in a shale country and think if properly burned there can be no better paving material produced from clay. If they are burned hard enough and then cooled properly, or rather to use a more scientific term, properly annealed, as they should be, a brick can be produced which will last nearly as long as a granite block. The advantage of repressing is that it makes a solid, compact mass, which is more likely to burn hard than the ordinary product of the "pug mill." The advantage of beveling the edges is that it gives the horses a better foothold. The common paving brick has sharp edges, which are bound to be broken off, so that in the course of a few years the edges present the appearance of having been roughly beveled. The repressed block presents smooth beveled edges, impervious to water, while the raw edges of the ordinary brick, broken off by travel, are more likely to absorb water; but the whole question of absorption of water does not cut much of a figure if the material has been properly burned. I have the first case yet to see of water getting under the pavement and causing the frost to displace the brick.

Paving thoroughfares with brick is by no means a modern invention. There are country roads in Belgium that have been paved with brick over a hundred years.

The question of durability is largely one of skill in burning the brick properly. A perfectly annealed brick, like a fine tempered piece of steel, will outlast the man who made it. I would place the life of a well made brick pavement on a residence street in any ordinary sized city at a hundred years. Indeed it is purely problematical how long such a pavement will last. It might not last forever, but seems to a finite understanding almost indestructible.

We have never used tar to fill in between the brick, deeming it unnecessary. It costs considerably more to do it, and in case you have to open the pavement the brick are so firmly stuck together that they have to be thrown away. Six months of a pavement will fill the interstices, if any should remain unfilled with sand, as firmly as need be. We can take up our street pavement at any point and find the sand underneath dry, show-

ing that the pavement is impervious to water.

An important question is the cost of brick paving. Many cities before they come to the period of brick paving try various expedients by treating the streets with gravel, slag or macadam in the vain endeavor to make a satisfactory street at small cost, and nearly if not quite enough money is thus spent in these more or less fruitless endeavors to pay for a good brick pavement. "You pays your money and you takes your choice"—granite block, Belgian block, cedar block, asphalt or brick, but all things considered, brick is the cheapest and the best for ordinary traffic.

I am sure the ease with which a wheel passes over a brick pavement is a great advantage compared with any kind of a stone pavement, and it is a more sanitary pavement, for granite, Belgian or cedar block catch a great deal of refuse matter which is bound to be left to fester in the sun and cast its mal-odor into places of business or residences and taint the atmosphere of the street with more or less danger to health. Besides that, the ease with which a brick pavement can be repaired is a great advantage. Every brick is from the same mold and always ready at hand to repair a break.

Again, the thorough manner in which a street sweeper will clean a brick pavement recommends it over all others unless it be asphalt, but it must be remembered that asphalt costs nearly twice as much as brick and therefore ought to be superior in many ways to brick.

For heavy traffic I would recommend broken stone and concrete foundation, but for residence streets sand and gravel is good enough. To the average citizen, however, the question of cost is decisive as to material, and it turns out that brick is the favorite.

Our first improvement, begun in 1891, was of standard brick and cost $1.08 per square yard of finished pavement; Berea curb, 35 cents per lineal foot, laid in place. The next year we tried repressed block at a cost of $1.14 per square yard. Our last letting this summer was at 65 cents per square yard for standard brick, one-third fire clay and two-thirds shale, and 33 cents for Berea curb. We also paid $400 extra for the use of a steam roller and consider it a good investment.

Since the advent of the bicycle we have had everywhere a revival of the good roads idea, thanks to the energy and enthusiasm of the bicycle clubs throughout the country. The bicycle has come to stay, and so has the determination to build good roads come to stay. It will not down until all the main country thoroughfares are properly graded and paved. I believe it is pssible to pave the country roads with brick. Let the paved roadway be sixteen feet wide, or even less, crowned slightly in the center, with curb of rough stone, set down even with the surface on each side, so that in dry weather teams could take the dirt road on the side, if desirable. Some equitable arrangement could be made between state, county and land-owners and thus make the cost to property-owners as light as possible. The property on either side of such roads would be greatly enhanced in value and the isolation of country life be reduced to a minimum. With such roads the farmer living fifteen or twenty miles from the city market could drive at a fast gait with loaded wagon, deliver his produce in town and get back home in time for supper, and do it with very little effort either on his part or that of his team.

Some one has said that the condition of the roads of a country are evidences of its progress in civilization. The same might be said of the bath-room. But many communities might be willing, but not have the power to construct proper roadways or bath-rooms. Good roads and handy materials go together the same as bath-rooms and water works. First, then, well-paved streets are indices of a higher civilization; second, they are evidences of prosperity; third, they promote prosperity; fourth, they add to the abutting property all they cost and in most cases more.

It is claimed that there is but one finished country in the world and that is England, with her fine roads and well paved streets, with her superb landscapes containing forest and field duly regulated and cared for, but England's perfection is the growth of centuries. We cannot hope for a finished municipality or country-side. We are too young to realize that yet; but each set of officials must act their part faithfully and carry forward all public works that fall to their lot with a view to ultimate perfection and to supply the demands of the future as well as the present, trusting that in coming years both city and country will arrive at a stage of completeness, and then we shall have the best land for habitation in the world.

RUMBLING OF BRICK PAVEMENTS.

By Ernest Adam, City Engineer of Newark, N. J.

(The introduction to Mr. Adam's paper gives details regarding the construction of brick pavements in Newark, on which there has been unusual rumbling noise. This has been fully described in previous numbers of Municipal Engineering. Mr. Adam's account of the investigation and his statement of conclusions are given below:)

As some of the property-owners along the line of these streets made complaints I began to investigate the cause of this noise, and attempted to find a remedy for it in the pavements already laid. I solicited information upon the subject from a number of engineers in other cities where I knew that considerable brick paving had been laid for a number of years.

From the information received through this source and my own observations I came to the conclusion that in order to avoid this objectionable noise it was necessary to abandon the exclusive use of cement grout. In the city of Brooklyn, N. Y., one of the streets paved with brick and the interstices filled with cement grout also caused an almost intolerable noise. Mr. N. P. Lewis, Engineer of Street Construction and Maintenance, according to a recently published article, entitled, "Trouble With Noisy Brick Pavements in Brooklyn," attributes the cause of the noise to the fact that the paving was done in cold weather, during which the sand cushion and probably the surface of the concrete was frozen at about the time the bricks were rolled; and as the frost worked out it caused the sand and concrete to shrink, producing a void under the bricks, and consequently a noise.

My experience with the brick pavement in South Tenth street and Congress street, where I am positive the frost had not affected any material, contradicts the theory of Mr. Lewis.

In fact the noise in South Tenth street is greater than in Johnson avenue, where salt was used in the grout. Mr. Lewis also attempted to remedy the evil, but according to the article mentioned, he abandoned all efforts, because he found the noise spread over the greater part of the street. Mr. Lewis then tried to crush the paving down with a 15-ton roller, but it was impossible.

There seems to be no doubt that the noise is caused by a void under the bricks, which is produced by certain conditions; this I would principally attribute to expansion.

In the city of Wilmington, Del., where the same difficulty was experienced in a street paved with brick, the engineer informed me that a strip of 100 feet in length and 18 inches in width was cut through the center of the pavement, thinking it would relieve the noise, but did not accomplish the desired result.

In Easton, Pa., where I went to make some observations upon brick pavements, I saw a street with an 8 per cent. grade. On account of the steepness of the street it was considered necessary to fill the interstices near the gutter with cement grout. This was done to the width of four feet from the curb. The balance to the car track had a sand filling.

Along the entire length of the block a slight ridge of one-half to three-quarters of an inch in height could be traced along the division line, showing a general settling of that part of the paving in which sand had been used. In fact, a large number of bricks which lapped from one into the other were broken on the division line.

On the brick pavements in Easton, where the joints are filled with paving-mastic or sand, there is no uncommon noise, but the edges of the bricks in some streets are considerably worn off, leaving but three-quarters to one-half the original surface. This observation, and the opinion of other engineers, made me come to the conclusion that the durability of a brick pavement would be sacrificed to a great extent if either paving-mastic or sand were used.

The theory of expansion in brick pavements was clearly proven by an ocular demonstration in Johnson avenue, which is paved with fire-clay blocks, as previously stated.

Upon May 10, this year, when the temperature was 94 degrees in the shade, the pavement was heaved to a point where the avenue forms a summit; it is

said that a loud noise accompanied the rupture. The break formed an arch with a 9-foot span and an 8-inch rise, and extended from curb to curb, 42 feet.

The laterial expansion could be traced along the curb line for a distance of 120 feet in one direction to a street intersection, and for 200 feet in the opposite one; the cement grout was loosened from the curb. The pressure was so great that a number of the bricks were broken, which had been forced out of place, and many showed a horizontal rupture.

The difference in the measurement over the top of the arch and its span was .07 of a foot.

In Carnegie's Hand-Book for 1893, on page 190, is given a table of linear expansion of substances by heat. Applying the co-efficient of expansion given for fire brick, and calculating the linear expansion by taking the difference of temperature between the time of the rupture and when the pavement was laid, at 85 degrees (110 degrees—25 degrees) it singularly produces almost the same result, namely, .081 of a foot.

No rupture like this has occurred in any of the other streets, although there are bulgings, but more so in the fire-clay than in the shale brick pavements.

As previously stated, the pavement in Roseville avenue was not commenced until the month of May, this year. The experience had with cement grount filling should have caused us to abandon it in this case, but the specifications in the contract, which had been awarded last year, required such a filler.

When three blocks of the avenue had been paved in the ordinary way a different method was adopted in finishing the remaining blocks. A thin board, one inch thick and five inches wide, was placed against the curbstones before the bricks were laid, with small wedges set between the curb and the board, so that it could be removed after the bricks were rolled with a five-ton steam roller.

It was necessary to fill the ends of the joints next to the curb with cement mortar, in order that the paving-mastic, which was afterward filled in the space left by the board, could not spread. At both ends and in the middle of the block a strip of the pavement across the full width and 15 feet in length was also poured with the composition. The block is about 800 feet long. This device was was that ordinarily used in improved stone block pavements. This device was adopted in order to provide for the lateral and transverse expansion during hot weather.

The pavement treated in this manner, so far, does not cause any uncommon noise, whereas in the first three blocks it was very soon experienced after the pavement was finished, but not as loud as in the streets which were paved last year.

As the whole work was not completed until the latter part of August I cannot positively state, as yet, whether this method will give satisfactory results; still it is encouraging.

I certainly agree that it is far better to lay brick pavements during the summer months than when cold weather is liable to affect the materials.

THE QUESTION DEPARTMENT.

[By J. W. Howard, B. L., C. E., for MUNICIPAL ENGINEERING.]

SPRINKLING STREETS WITH SALT WATER.

I very much desire information about the effect on vehicles, clothing, etc., of dust from streets sprinkled with salt water. It is very effective in laying dust and preserving macadam. I have been told that accumulations of salt prove injurious and objectionable if the streets become dusty.
M. K. Miller, Street Supt., Oakland, Cal.

Salt water is excellent for sprinkling all streets paved with stone blocks, asphalt and bricks. No accumulations of salt occur upon such pavements. Any excess of salt water runs off and has a cleansing effect superior to fresh water.

Upon a macadam surface and that of telford roadways salt water lays the dust nicely. If you keep your macadam surfaces in good condition, sweeping or scraping accumulations of mud or dust from them, and if you keep the gutters

free and in good alignment, you will have no salt accumulations. The writer of this has been in Oakland at long intervals and believes that the rains there each year are alone sufficient to correct any possible salt-charged dust in your city. Very few cities have cheap salt water available. If you used it to economize your fresh water or save expense of purchasing it from a private water company, by all means sprinkle with salt water, which will be an additional incentive to keep your streets clean and in good order. Whether or not you can use it on earth roads is a local question or one of drainage in rainy weather when any salt would be washed away.

PRICES OF ACCESSORY OR EXTRA WORK IN CONNECTION WITH PAVEMENTS.

Our officials have visited several cities and learned of the practice of naming the price per foot to be paid for new curb set, for resetting old curb, for sewer catch basins, and for relaying other kinds of connecting pavements than the kind upon which competitive bids are to be received and which is to go on the street named. Is this a good system to use?

N.N. of Street Dept., St. Louis, Mo.

The tendency is as you suggest. It is well for the city engineer or proper official to state in the written specifications reasonable prices known to include a very small possible profit (say 5 per cent.) for the various kinds of accessory or extra work necessary when a street is to be paved. Also, fix a price per cubic yard for all grading in excess of the depth occupied by the paving. This confines the bidding to the pavement proper. Unbalanced bids and "straw items" are eliminated. Better and more economical work will more easily result than by throwing open all items to misleading and unbalanced bidding. The surface material and the foundation of a pavement should be regarded as the whole pavement, and the price bid per square yard should include this whole pavement. Permanent records, comparison of prices and sure progress is thus assured. Involved, blind and complicated bids soon cause trouble to the public officials and others.

DESTRUCTION OF WATER PIPES BY ELECTROLYSIS.

What should be done to prevent electrolysis destroying our city water pipes? The city is put to great expense by this.

Chas. Wingate, Brooklyn.

The damage done in New York and other cities is very great. Probably, in the end, it will be much more expensive to repair the injured water pipes and house connections than the total amount of taxes paid into the city treasury by the trolley traction companies causing the damage. The expense of constant city inspection, repairs and renewals, due to electrolysis, should be added each year to the regular taxes collected from the trolley companies. The electric damage done to other than public water pipes should also be borne by those responsible for the injury.

This subject was fully treated in MUNICIPAL ENGINEERING, July, 1896, page 31, and the best known practice to reduce its injury was there given. Complete elimination is not yet known.

COST OF A SMALL MACADAM ROADWAY.

Can you give an approximate estimate of the cost of a roadway for ordinary hauling, about 250 feet long, on very sandy soil, the roadway being free from all obstructions and requiring very little grading? I can get broken stone for about $2 per cubic yard delivered, and have an old roadway very close to the proposed road from which I may be able to get good foundation stone, if such is required.

P. S. Crutcher, Louisville, Ky.

The conditions given are not sufficient for the editor of this depart-

ment to closely approximate the cost. It is necessary to assume that you would make a road 12 feet wide, which is a fair width for such a short section. The amount of grading, which you state is very little, is best assumed as double the thickness of the thinnest macadam roadway which it is safe to construct. It is necessary to assume that you would make your macadam at least 6 inches thick, also that you would use some stone as a course foundation taken from the roadway which you state is at hand. Assuming that labor is $1.50 per day, and one-horse dumping carts $2.50 per day, the conditions given in your question, combined with the above assumed conditions, the cost of the small piece of roadway, well laid, would be about as follows:

75 cu. yd. of crushed stone at $2	$150.00
Putting together, rolling, etc., 333 sq. yds. @ 25c	83.25
Total	$233.25

Including profit, it would be safe to appropriate $250 for the work, although it could be done for less in proportion to the quality of the work. A few facts concerning the quality of the stone for macadam and the cost per mile of road, are given in MUNICIPAL ENGINEERING, Sept. 1896, page 154.

The above question is published and answered not so much in order to give the cost of such a piece of work, but to illustrate the necessity of an engineer having complete data on roadway as well as other constructions before he can foretell even an approximate cost of work.

TESTING LABORATORIES.

Please name a testing laboratory with experience in practical tests of the materials of pavements and other public works for our possible use.

Richardson & Co., New York.

We refer you to the advertising pages of our present and back numbers. This question often arises in some form.

STANDARD ENGINEERING POCKET-BOOKS.

Please name some practical and convenient engineer's compendium on materials, methods, etc., for ready reference for a newly appointed assistant in connection with town improvements.

W. B. Benson, Farrington, Me.

Examine carefully Trautwine's pocket-book and Haswell's pocket-book; one requires a higher technical education than the other. Both are practical. They cost $5 and $4 respectively. There are others.

ASHES SHOULD NOT BE USED UNDER PAVEMENTS.

In our city the horsecar companies often use ashes under the stone block pavements, between the rails of their tracks. It is not used so much between the tracks where the trolley electric cars run. Will you please decide a discussion between myself and another gentleman as to whether ashes should be used there or not? *A. H. Quinn, Jersey City, N. J.*

The answer is brief: no ashes should be used, even when mixed with sand or gravel, under the pavements of the roadways of the streets of cities. Ashes are too soft, even when fresh, to give a solid setting to paving blocks. Furthermore, when the water from rains percolates through them, a large portion of the ashes is dissolved and carried away into the soil, causing irregular depressions in the pavements. The use of them near the rails of electric lines is likely to cause much damage to the return wires underground, as well as the electric connections between the rails. No good electrician would for a moment permit a combination of ashes, water and the acids of street filth to lie in contact with the electric conductors and rails. Pavements, whether of stone, blocks or bricks, should be upon a cushion of good sand or

fine gravel, whether a concrete foundation is under them or not.

CHOICE OF PAVEMENT AFFECTED BY KIND AND QUANTITY OF TRAFFIC.

Is it not important that the choice of a paving material should be determined after a careful estimate of the nature and volume of traffic to be expected for a long period of years? Would it not be safe to expect that rubber tires and ball bearings will soon be more extensively used on vehicles? *F., Providence, R. I.*

The kind and quantity of traffic found upon the roadway, as well as that which may be reasonably expected, are important factors in the problem, but not the only ones. The questions of health, ease of traffic, street cleaning, noise, are as important. The pavement for a street must not be studied entirely from the standpoint of the horse and vehicle, because of the many other purposes fulfilled by a street than that of the transportation of people and materials on wheels and drawn by horses.

As to rubber tires and ball bearings, they will probably be found upon but a very small proportion of the carriages in use, and probably never upon business wagons. The bicycles deserve full consideration in the problems of street paving, for their use is extending rapidly in the fields of business and necessity. The numbers in use are steadily increasing in these fields, as well as in pleasure.

GATES AT RAILWAY CROSSINGS.

Please indicate what class of roadway gate is most used at places where railways cross streets on grade. There is a prejudice here in favor of a form found here and in several New England cities. It is a stiff grillage, four or five feet high, extending across roadway and sidewalk. It is raised so that it is above, but still across, the roadway. *L. F. Hallwood, Malden, Mass.*

The form you mention, known as the "fence gate" class, has been discarded except at a few places in a few cities where cross traffic is very large and there are many trains.

The class in almost universal use in America and Europe is that which has a counterbalanced arm across the roadway; for wide roadways two arms. These arms turn upon pivots near the balancing weights. There are several kinds, makes and patents. They are undoubtedly familiar to you, and, with few exceptions for special local reasons, they have long since replaced all others.

[By Charles Carroll Brown, M. Am. Soc. C. E., for MUNICIPAL ENGINEERING.]

SPECIFICATIONS FOR LAYING WATER PIPE.

I would like a brief specification for the laying of water pipe, more particularly for making the joints. *E. M.*

The following will probably cover the points desired: Trenches being dug the proper width to allow plenty of room for work, and the specified depth for the climate of the locality, must be smooth on bottom and to grade, with additional excavation to give plenty of room for hubs of pipe and for work on them. All pipe must be thoroughly brushed out and cleaned while being laid, and particular care must be taken with the surfaces of hub and spigot to make and keep them clean. The spigot must be so adjusted in the hub as to give a uniform space for the lead joint, which joint, except by special order, should be at least five-sixteenths inch for 12 inch pipes or less, and three-fourths inch for larger pipes; in pipes of 16 inches or more diameter, the engineer may permit the joint to be closed on the inside of the pipe with clay, so that the entire space between spigot and hub may be filled with lead, but for smaller sizes the pipe should be

rejected if the space is less than that specified. When the pipes are carefully adjusted, hemp yarn will be driven into the space to prevent lead running into the interior of the pipe, leaving at least 2½ inches of depth for lead. If it is suspected that lead has run into the pipe the joint should be cut or burned out, examined and made anew. Iron plugs or caps must be leaded and caulked into open ends of mains or laterals not to be extended shortly, with proper bracing behind them as directed by the engineer. Wooden plugs may be used on his direction. End of pipe must always be closed by plug when pipe laying is stopped for any length of time, to keep dirt and water out of it. Competent mechanics must be employed for yarning and caulking that the joint may be well filled without needlessly straining the pipes. Hydrants must be set vertically in place, resting usually on a large wooden block securely set in the bottom of the trench. Stop gates must also be set vertically on similar blocks at exact points designated and all joints carefully made. When necessary to cut the pipe, it must be done with proper and sharp tools, so as not to crack or break the pipe longitudinally. Lead must be melted in pots not more than fifty feet from the joint, and poured into the joint from hot ladles before it has any tendency to solidify. For pipes less than 12 onches in diameter, the ladle must hold enough to completely fill the joint. Two ladles must be used for larger joints, both being within reach of the operator during the operation, and being used in rapid succession. If the dam breaks or it is found that less than the specified depth of lead is used the joint must be burned or cut out and made anew. Whenever possible the joints should not be covered until the pipe has been tested and all leaks or defective joints of pipes or castings located.

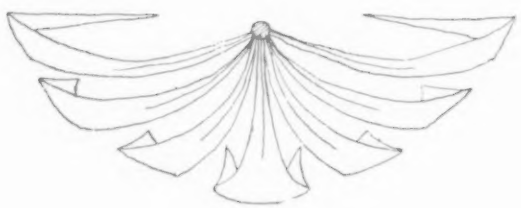
SETTING STAKES FOR SEWER GRADES.

Will you give some of the most convenient and at the same time reliable methods by which an engineer can set stakes for sewer grades on the surface?

C. N. Schwab, Napoleon, O.

Perhaps the simplest reliable method is the following: The center line having been located and the trench laid out and partially completed, set stakes in the foot or so of bench left between the edge of the trench and the toe of the pile of dirt thrown from the trench. Unless the soil is very soft and the bracing and sheet piling of the trench are not good, the stakes will stay as long as they are needed. The stakes may be set at distances of 25 feet or 50 feet along the trench, as is most convenient for the particular work. The number of stakes to be set in advance of the work will depend upon the peculiarities of the foreman or contractor, the time of the engineer, the care and competency of the workmen and inspector, the character of material, etc. Where gradients are flat the stakes should be checked up before the final trimming of trench and laying of pipe, if they have been set for any length of time, or there is danger of accident to them. The cuts at various points along the street may be given to the contractor and he can excavate within two or three feet of the grade without stakes, if he has experienced foremen, and in that case only one setting of stakes will probably be necessary. For making the final measurements of trench and for laying pipe or setting centers for brick-work, the contractor and inspector can drive a stake on the op-

posite side of the trench to the same level as the stake set by the engineer, by means of a straight-edge and level. A frame set over the ditch will hold a vertical board, one edge of which can be set on the center line of the trench by measurement from the stakes or by lining in. A notch can be cut on this edge an even number of feet above the grade-line of the sewer, located by measurement from the bottom of the straight-edge. Such frames and boards being set opposite each of the engineer's stakes, a cord stretched between them will give line and grade, which can be transferred to the bottom by a tape line or pole graduated to feet with a projection at the bottom to slip in on the flow line of the pipe. The cord should be above the surface far enough to be out of the way of lowering materials. If inspectors can not be trusted to set the frames for the line, they can be set by the engineer, and the duty of the inspector will be reduced to bringing the pipe to grade by comparing his foot-mark on the rod with the cord. On page 35 of the July number of MUNICIPAL ENGINEERING will be found some further description of this method of laying pipe sewers. If the soil is firm and sheeting is not necessary, stakes may be driven in the sides of the trench say five feet above the flow line and the cord stretched from stake to stake. The cord being on the side of the trench, neither line nor grade will be quite as accurate as by the above method, and it is therefore better fitted for steeper gradients. Line can best be tested by laying with a light at the last manhole.



BY WAY OF COMMENT.

State Control of Water Supply and Sewerage Systems.

A sentiment in favor of a certain control of water and sewerage systems of towns and cities by the state is gradually growing. In Massachusetts it has advanced so far that all systems of water supply and sewerage must be approved by the state board of health in both engineering and sanitary features, before construction can be begun, and the state board of health can take action on any matter requiring its attention in connection with old systems, and in connection with extensions and improvements. In New York the state board of health must approve of the sanitary and engineering features of plans for proposed systems of sewers for villages and has certain duties to perform on request in connection with the sanitary features of water supplies. In Ohio the state board of health must approve of the sanitary features of plans for sewerage and water supply. The first idea of such state control arose in thickly settled Massachusetts on account of the pollution of water supplies from various sources and the necessity of referring the prevention and amendment thereof to a central authority. The board of health being the sanitary authority of the state was naturally the body to which to refer the matter. This board, seeing the necessary connection of the sanitary and engineering features has considered them together, practically without distinction, and has a strong engineering bureau in its organization. The same is true of New York as far as its work extends. In Ohio the sanitary features only are considered by the board. The experience of these states, and others which have applied the same principles in less degree, shows the impossibility of making satisfactory decisions without full consideration of all sides of the question. The more thorough the control the better the results. Another reason, possibly savoring of paternalism, for establishing a competent engineering bureau in connection with the sanitary authority to which to refer such questions, is the ignorance of the public in regard to engineering questions and as to competency of engineers, and the consequent certainty that much work will be done on defective plans or without plan, and much money will be wasted. The existence of the state board of health is really based on a paternal theory of government.

State control of the combination of sanitary and engineering features will result in great benefit to the people in sanitary and financial directions and to the engineering profession by raising the standard of professional service, provided the controlling authority is placed in competent hands. Illinois and Indiana are taking steps toward the establishment of such control over plans for water works and sewerage and pollution of streams, and the suggestions made thus far ap-

proach more nearly the idea exemplified in Massachusetts than that of Ohio.

Sioux City Brick Paving Specifications.

The city engineer of Sioux City, Iowa, Mr. L. F. Wakefield, has prepared forms of specifications, contract and bond for brick pavements which are quite complete and up to date. A few points are deserving of special mention. Bids are received per square yard of pavement laid. Curb, drain tile, and extra grading and materials are bid upon as extras. Bids are also received for maintenance for each five years of a period of fifteen years. Payments are made on completion and acceptance, in special assessment certificates. Round corners of two feet radius are set at street and alley corners. The great improvement in appearance of street by using corners of larger radius, and the less wear on the corners, much more than pays for the additional area of street surface. Radii of four to six feet are almost always possible, and where the roadway is narrowed for the new permanent pavement, a radius of ten feet can sometimes be used without interfering with proper construction of sidewalk. Surplus earth must be delivered where directed, and allowance is made for haul over 1000 feet at price bid. If the earth is needed by the city this method is excellent, and the city should pay the overhaul. If the earth is to be wasted, so far as the city is concerned, a less price can usually be obtained for excavation if the contractor is permitted to dispose of the material in his own way. Full tests of cement for fineness and strength, neat and with various proportions of sand, and for time of setting are provided, and at the same time it is required that the cement shall be equal to the best obtainable in the markets. Some cements not equal to the best can pass the specified tests. The contractor is required to use city water at meter rates. The marginal finish at street and alley intersections is 3 x 12 inch plank held in place by posts 30 inches long. Where stone is as cheap as at Sioux City, stone would be a great improvement, unless the side street is to be improved in a short time. Porous sub-drains 3 inches in diameter in trenches 6 inches deep are to be laid when required by the engineer, these drains to connect with catch basins or storm water sewers. Tests for absorption, abrasion and transverse strength of brick are provided. A peculiar provision is that requiring the pavement to be thoroughly wet down after tamping so that soft brick may be detected. A report on the practical working of this provision would be of interest. The disturbance produced by taking out soft and defective brick after tamping makes it difficult to replace the surface perfectly. An excellent provision is that fixing a standard for maintenance, and a condition when replacement becomes necessary. It reads:

As a basis for interpretation of the ac-

ceptable condition of the pavement at any time during the period of maintenance, the paving material must be sound, and the wearing surface of the roadway must be no less than 75 per cent. of the thickness specified for the original pavement at the end of the maintenance period, and at intermediate times a proportionally greater percentage, the thickness to be determined at a point subjected to average traffic. It shall be in a reasonably smooth condition for travel.

Payments for maintenance are made semi-annually on approval of city engineer and paving committee. Persons cutting into streets must replace the trench according to ordinance, and the paving contractor will replace concrete and wearing surface at the original price per square yard. The division of responsibility for the trench leaves the question of future repair in dispute. Better service will be obtained by making the paving contractor responsible for the entire trench after the pipe is safely covered.

Paving Brick Tests. An interesting subject of discussion at the recent meeting of the American Society of Municipal Improvements was that of the best methods of testing paving brick. The chairman of the committee on paving, Mr. A. D. Thompson, was also a member of a committee of the Illinois Society of Engineers which reported against the formulation by that society of a standard programme of tests. The same conclusion was reached by the committee of the Association of Brick Manufacturers. In a recent number of the *Journal of the Association of Engineering Societies* is a paper by Mr. F. F. Harrington of the St. Louis Engineers' Club, giving the results of some experiments made in the testing laboratory of the board of public improvements under the general direction of Mr. M. L. Holman, water commissioner, and using special machinery when necessary, of which Mr Holman is the designer.

The tumbler tests were made to determine, (1) the volume of the barrel which should be filled with brick to secure the maximum percentage of loss, other conditions being normal, and it was found that the brick should fill 15 per cent. of the volume of the cylinder; (2) not less than ten to fifteen brick should be tested at a time, and (3) cast-iron blocks used with the brick do not give as uniform results as the brick alone; (4) length of cylinder need not be considered, as change in length has no effect if the relative volumes remain as stated; (5) the cylinder used was 24 inches in diameter and no experiments were made on the effects of difference in diameter; (6) the cylinder was revolved at speeds varying from 20 to 40 revolutions a minute, and it was discovered that the percentage of loss increased more rapidly than the speed increased. The experiments do not show the speed at which the maximum loss would occur, but it is more than 40 revolutions a minute for a 24-inch cylinder; (7) the percentage of loss decreases each successive minute of tumbling, and it is recommended from a study of the curves showing these percent-

ages that the time in the cylinder be placed at 40 minutes, at 30 revolutions a minute.

The tests for absorption showed that it takes about forty-eight hours at a dry temperature of 220° to 240° F. to drive the moisture from the brick. If the brick have been in water for twenty-four hours before drying, about 90 per cent. of the moisture will be driven off in forty-eight hours, and all in ninety-six hours or less. The brick then immersed in water continue to absorb water after twenty-four weeks, and a uniform rate of absorption is approximated very closely only after eight to twelve weeks, so that a fair test of absorption can only be obtained after a long interval, not less than eight weeks. Broken bricks and pieces absorb more than new brick, so that bricks which have been through the tumbler test should be used.

The cross breaking tests are awaiting the construction of a machine designed by Mr. Holman, and to have a capacity of 20,000 pounds, and crushing tests will be made on a machine with a capacity of 1,500,000 pounds. Mr. Holman stated to the American Society of Municipal Improvements that freezing tests would also be made as nearly as possible under the same conditions as in actual use, and that specific gravity and hardness will be determined. The homogeneity and lamination of brick are studied by means of slices split off the brick by a very ingenious machine of which the essential parts are a steel straight-edge, a three-cornered file and power applied thereto.

Asphalt Reservoir Linings. In a recent volume of the transactions of the American Society of Civil Engineers, Mr. R. B. Stanton gives a description of a method of applying asphalt to lining reservoirs, which differs somewhat from previous methods and seems to have been successful. Usually one or two thin coats of asphalt or of a mixture of asphalt and sand have been used. The first coat of two is the softer and fills up the interstices on and near the surface, and the second is harder and usually thicker. From one-sixteenth to one-fourth of an inch is put on in each coat. There is a tendency in warm weather for the asphaltum to flow down the slope and thus leave openings for water to escape when the reservoir is again filled with water. In the discussion of the paper experiences were given showing such difficulty in many places. Mr. Stanton constructed the lining of one reservoir by boiling four parts of California refined asphaltum and one part of crude petroleum together until the mixture when cool would be tough, elastic and pliable, though very brittle when quite cold, and adding this to heated stone in such proportions as would thoroughly coat every particle of stone, and depositing the mixture on the surface in a layer about four inches thick. This construction has stood two hot summers and one cold winter without injury. He recommends for more

permanent work than that described the stepping off of the surface in steps of three or four inches width, to save expense in making a smooth stone surface, and the application of an asphaltum concrete layer one foot in thickness. The members discussing this proposition agree that this thickness would render the lining more liable to flow and would increase the expense more than the preparation of the bed would amount to. The four-inch layer was made and put down for fifteen cents a square foot, and Mr. Stanton estimates that in large quantities, with asphalt at $20 a ton and labor at $2 a day, a layer six inches thick could be laid for the same price. It is believed that the addition of the stone to make a concrete, if properly done, with good materials in proper proportions, will prevent the creeping, wrinkling and cracking of asphalt reservoir linings, which have taken place frequently when pure asphalt or asphalt and sand have been used. The cost may in many cases be reduced below that of the older method.

CURRENT INFORMATION.

REVIEW OF MUNICIPAL REPORTS.

The report of M. K. Miller, Superintendent of Streets of Oakland, Cal., for the year ending June 30, 1896, contains an excellent description of the most approved street pavements with special reference to the defects in the plans and methods of laying and repairing streets in that city. The Superintendent of Streets has the same duties as the City Engineer in other states, and he is subordinate to a Board of Public Works, who in turn are subordinate to the City Council, which body has entire control of the public improvements. Most of the difficulties which are mentioned in the report arise on account of the lack of system, and the influence of prominent property-owners, due to the fact that councilmen are not experts in the conduct of public work, are not continued in office long enough to become so, and are too apt to follow the wishes of their influential constituents rather than the economic laws of public improvement. The experience of California cities, as of those in many other states, demonstrates the desirability of an expert control of planning and carrying out of public work, such as would be secured by the appointment of a non-partisan Board of Public Works by the most competent authority in the city, perhaps the Mayor, which Board should have entire control of the determination of the methods of and material for a proposed improvement. The City Engineer or Superintendent of Streets should be a prominent member of the Board, perhaps its president, and should be the judge of technical matters. The Board should be as nearly continuous as possible, not more than one-third of it changing at any one time. The council should have no power to change the plans for an improvement presented by the Board for approval, but should ordinarily have the power to decide whether the improvement shall be made or not.

Of the 169 miles of street in the city ninety-seven are macadamized, and much space is taken up in showing the defects in the present methods. The cost, given at 7 cents a square foot, indicates a low grade of improvement unless materials are exceptionally cheap. Many of the streets have been neglected, and it is proposed to resurface them by loosening the old macadam with a spiked steam roller, to a depth of two inches, adding a dressing of new rock and screening sufficient to give a smooth convex surface and watering and rolling thoroughly. This should give a good residence street, and is estimated to cost about 3 cents a square

foot. Argument is made for a plan providing for paving the business streets with asphalt or bituminous rock, at a cost of about 24 cents a square foot, the residence streets with macadam at 7 cents at the cost of the property-owners, and that main thoroughfores leading from the city to outlying towns or country be paved one-half at the cost of the property and one-half of the city—the first two as the property is directly benefited and the last because the heavy travel is rather a detriment than an advantage, as such thoroughfares in the smaller cities are neither business nor desirable residence streets.

The water works of Grand Rapids, Mich., are under the control of the Board of Public Works. During the year ending June 30, 1896, the receipts were $89,465.21 from all sources, and the expenditures for operation and maintenance were $46,774.57, the excess of receipts being $42,690.64. These receipts do not include any appropriation by the city for fire or other purposes. The annual interest charge is $41,685, so that the water works income pays all charges, with no margin for additions and improvements. These are made by special appropriations, which take the place of annual appropriations for public uses. During the year $74,609.71 were paid for additions and improvements, including a new triple expansion pumping engine with capacity of 15,000,000 gallons a day and extension of mains, including part of a new supply main. The total cost of the works is $1,276,576, and the bonded indebtedness is $887,000. Since May 1, 1874, when the city took charge of the works, the total receipts have been $814,704.12, and the expenditures for operation and maintenance $457,392.33. These figures would indicate that the works have not always been able to pay the interest on the bonded indebtedness, and their ability to do so now is evidence of improvement. A sinking fund for the extinguishment of the debt and to take care of necessary additions and improvements could be obtained by a reasonable annual appropriation proportional to the fire service rendered, and would be an economical measure if the fund is carefully guarded. The tendency under the present method is to increase the bonded indebtedness and therefore the annual interest charge, for every addition to the works, and to neglect provision for taking up bonds when matured, thus piling up indebtedness for the future and increasing the future annual fixed charges to save a little increase in present tax rate.

The new engine seems to be a very economical machine, as shown by the figures of the test and the reduction in cost of pumping. The duty, based on 1,000 pounds of steam at 125 pounds per square inch in boiler from feed water at 100 degrees, is 151,025,400 foot pounds as the average of a six days' test, the capacity being 15,505,155 gallons a day 2 per cent. allowance for slips, delivered at a pressure of 74.4 pounds per square inch, with a suction lift of 6.76 pounds.

The City Engineer's report of Gloversville, N. Y., for 1895 shows 1,128 feet of brick pavement laid, costing $2.23 a square yard on concrete foundation. This cost is rather large, probably on account of heavy freight on brick. The city has forty-two miles of streets, three of which are paved with brick or wood. There are twenty-two miles of water mains and seventeen miles of sewers, 1.4 miles of which were laid in 1895, at a cost of $5,693.73. A map is given of the sewer system, which, with the statement of water mains, shows that the city is well supplied with local sewers. The map also shows that the sewers discharge by several outlets into a small stream, with several dams across it. The sewage and discharge from many factories and tanneries makes this stream a nuisance and an intercepting sewer will shortly be a necessity, with sewage treatment to prevent damage to Gloversville and its neighbor, Johnstown.

NEWARK WATER WORKS.

In 1890 the city of Newark, N. J., contracted with the East Jersey Water Company for a new water supply from the Pequannock water shed. The total cost of the new supply of 50,000,000 gallons a day is to be $6,000,000. Under the contract the supply of water to Newark began May 1, 1892, and in consideration of the retention by the city of $2,000,000 for the eleven years the company was to furnish to the city 27,500,000 gallons a day for that time, and to have the right to dispose of the surplus as it saw fit until 1903, when the full 50,000,000 gallons a day are to be supplied to Newark. The company operates the works and keeps them in repair during this period. A forty-eight-inch steel pipe was laid to carry the water from the collecting reservoirs to

the distributing reservoirs. The company prepared to furnish 20,000,000 gallons a day to Jersey City during the period until 1903, but notified that city about Jan. 1 of this year that they would be unable to furnish more than 12,000,000 as the carrying capacity of the forty-eight-inch pipe had been overestimated. As the contract with Newark cannot yet be fulfilled, there have been numerous conferences, and the latest news is that an agreement has been reached whereby the city pays $110,000 for some increase in the size of the supply main that must be laid by the company to fulfill the contract, and the company makes a rebate on this amount of $100,000 on account of a shortage of 2,500,000 gallons in the pipe line to the high service reservoir. The water is delivered to the distributing reservoirs of the city and from the point of delivery is in the hands of the city. The average consumption during 1895 was 22,200,000 gallons, an increase of 2,000,000 gallons a day during the year, and at times during the winter the consumption greatly exceeded the 27,500,000 gallons contracted for. A more general introduction of meters is recommended to keep the daily average below the quantity contracted for until 1903 if possible. The pumps for the old supply from the Passaic river are kept in readiness for use in an emergency, but no Passaic river water was used in 1895. It was necessary to renew mains on Belmont-ave. for two blocks each side of Eighteenth-ave. on account of electrolysis, most of the expense being borne by the Traction company. Isolated cases of electrolysis were noticed in other localities, but none of moment. The works have cost to the present day, $3,337,490.26. Bonded indebtedness is $3,492,000. The receipts for the year have been $622,432.87, of which $40,000 was received from city funds. The works have paid all maintenance expenses, renewal, expenses amounting to $68,418.97, $320,355 of interest and $129,000 to sinking fund.

CHICAGO'S BIG SEWER ASSESSMENT CASE.

Suit was brought before Judge Carter October 5 in the Seventy-ninth street sewer system case, which is the largest of its kind in the history of Chicago. It involves $1,300,000 of special taxes and twenty squares miles of property worth from $200 a foot to $5,000 an acre. The proposed sewer is sixteen miles long, and is the first attempt on the part of Chicago to utilize the drainage canal, which is nearing completion and which cost $20,000,000. The owners of almost one-half of the property taxed for the new sewer represent $600,000 worth of land along the proposed route, and is to pass through territory inhabited by the class of Chicago's citizens whose unpretentious homes have been gained by thrift and industry, and who are in danger of losing them if obliged to defray their proportion of the cost of the immense drain, in addition to their own expenses for improvements.

The total assessment against one property-owner, Mrs. Hetty Green, who has some interest in the proposed line of sewers, is $6,000, while that of Ogden, Sheldon & Co. is $3,000. The lawyers appearing for objecting property-owners number 107, while the city's interests are looked after by John D. Adair, chief special assessment attorney, and Mr. Metcalf.

STREET RAILWAY MANAGEMENT.

The fifteenth annual convention of the American Street Railway Association was held in St. Louis, Mo., Oct. 20, 21, 22 and 23. In point of attendance, program and exhibits this convention is pronounced the best in the history of the organization. The papers read and discussed were as follows:

"Track and Track Joints, Construction, Maintenance and Bonding," by M. K. Bowen, Superintendent Chicago City Railway Company, Chicago.

"Trucks," by John N. Akarman, Superintendent Worcester Consolidated Street Railway Company, Worcester, Mass.

"How Can the Revenues of Street Railways Be Increased, Taking Into Consideration the Collection of Fares, Method of Registry, Transfers, Use of Tickets or Cash Fare, and Attractions Along the Line of Road," by C. Densmore Wyman, General Manager Milwaukee Street Railway, Milwaukee, Wis.

"The Modern Power House," by Richard McCulloch, Engineer Citizens' Street Railway Company, St. Louis, Mo.

"Modern Overhead Electric Construction," by B. Willard, Superintendent New Orleans City & Lake Railway Company, New Orleans, La.

"Selection and Management of Employes," by W. F. Kelly, General Manager Columbus Street Railway Company, Columbus, O.

The officers elected for the ensuing year are as follows: Capt. Robert McCulloch, St. Louis, President; C. S. Sergent, Boston, Mass., First Vice-President; D. B. Dyer, of Augusta, Ga., Second Vice-President; C. F. Holmes, Kansas City, Mo., Third Vice-President; T. C. Pennington, Chicago, Ill., Secretary and

Treasurer; H. M. Little of New York, and H. H. Bradford of Cincinnati, C. H. Smith of Troy, N. Y., Harvey Scullin of St. Louis, G. M. Hopper of Des Moines, Ia., members of the executive committee.

The next meeting place of the convention will be at Niagara Falls.

A PLAN TO REGULATE STREET TRAFFIC.

A plan for regulating traffic on the Western boulevard is in course of perfection by Gen. C. H. T. Collis in New York City. The plan is, briefly, to divide the roadway to either side of the car tracks, each about twenty-six feet in width, into two strips of asphalt of equal size, and the strips nearest the gutter shall be laid in block asphalt for trucks, and the other in the white asphalt for light vehicles and bicycles. An alternative plan is offered, should this fail to meet approval, that the asphalt be left as at present, but to divide the roadway by laying a strip of white asphalt, about a foot wide, over the entire length of the boulevard. The plan further contemplates lining the strip of pathway that divides the avenue on either side with a row of trees, between which will be an asphalt walk for pedestrians, bordered with grass. The plan hinges upon Alderman Olcott's ability to get the board of aldermen to pass his proposed ordinance compelling the trucks and heavily ladened vehicles to keep to the gutter side of the thoroughfare where north or south-bound, and to travel in single file.

BRICK PAVING BETWEEN CAR TRACKS.

Brick paving between street car tracks is a matter of much interest to those concerned, in Springfield, Mass., during the laying of the S. Main street pavement. The board of supervisors asked, before the contracts were drawn, that the street department prepare specifications similar to those common in large cities which have laid brick pavements. The City Engineer drew the plans in accordance with the usages in Boston, Albany, Hartford and other cities. These called for the establishment of the grades of the street by the City Engineer, and for the use of a cushion of one inch of sharp, clean sand between the concrete and the vitrified bricks; the grades were made from curb to curb, and made so that the bricks between the rails should have their upper surface flush with the top of the rail instead of a little above the lower flange; that no part of the work should be changed or altered by the contractor except by the express sanction of the board in writing. The supervisors have, however, changed the specifications recently, so as to call for first, the placing of the bricks between the rails, so that their upper surface shall be five-eighths of an inch above the lower flange of the rail; and second, the lessening of the sand cushion in order to make this possible. Those who favor laying the brick so that the upper surface is flush with the top of the rail urge that this makes a bridge across the track so that the latter is scarcely noticeable to a team crossing it; also, that by having the brick on the inside of the tracks lower than the rail, trains crossing pound down the brick on the inner side. This is particularly noticeable where there are cross streets. The supervisors admit that "by laying the brick flush with the top of the tracks the crossing is made less noticeable, yet they think the very slight drop, less than an inch, will not be felt and will certainly be no damage. The damage to the brick, when laid flush, will be less, because there will be less of the brick unsupported and accordingly less leverage on those next to the track. By setting the bricks a little lower it is thought that more stability will be given. Damage to the bricks will also be lessened by making shallower, at least on one side, the groove in which the flange of the car wheel runs. With the brick flush, the wheel of a vehicle getting into this groove has difficulty in getting out and not only clips and loosens the brick, but is itself liable to wrenching. This would be true of bicycles as well as carriages.

AGAINST BRICK SIDEWALKS.

An ordinance is before the Council's highway committee for consideration, in Philadelphia, which is intended to prohibit the laying of any sidewalks in that city, except in the suburbs, if constructed of any material but asphalt, artificial stone or flagstone. The object of the ordinance is to dispense with brick sidewalks, which, it is claimed, seldom escape the action of winter frosts, resulting in unevenness often to a dangerous degree. The ordinance is offered by Councilman Goheen of the Twenty-seventh ward.

A MUNICIPAL OWNERSHIP LEAGUE.

The Municipal Ownership League, Alameda, Cal., has pledged itself to support no candidate for the State Legislature who is not pledged to favor municipal ownership of electric lighting plants. The League will also make an effort to have a law passed by the next legislature which will provide that all cities of the fifth class of Califronia shall have the power to use their own system of electric lighting.

THE BINDER COURSE IN ASPHALT PAVING.

Inquiry regarding the use of a binder course between the concrete and the asphalt by the city authorities at Springfield, Mass., elicited the following information:

Mayor Powell, Engineer in Charge, Washington, D. C.—"The binder course shall be composed of clean broken stone, equal in quality to the stone used in the base. While hot it will be hauled upon the work and spread upon the base to a thickness of two inches, so that when compacted it will be at least one and one-half inches in thickness and immediately rammed and rolled until it is cold."

Edward P. North, Water Purveyor, New York City—"Your esteemed favor asking me if it is the custom here to employ a binder coat laid on the top of the concrete base where Trinidad sheet asphalt is used, is at hand. In reply I beg leave to say that it is the custom. The binder coat should, I think, be used with all asphalt pavements, as it keeps the pavements from creeping."

N. P. Lewis, Engineer Local Improvements, Brooklyn—"We always use a binder of broken stone and asphalt one inch thick over the concrete foundation. One or two streets were laid with a cushion coat of one-half inch of asphalt immediately on the concrete, but we consider stone binder preferable, as the pavement is less likely to crawl. Up to two years ago a coal tar binder was used, but lately we have been using asphalt exclusively."

Percival W. St. George, City Engineer, Montreal, Can.—"I beg to inform you that we put a binder coat on top of the concrete before the asphalt is laid."

The city surveyor, Bridgeport, Conn., sent full specifications which called for a cushion coat one-half inch in thickness. A binder is used in Toronto, except where the asphalt is thinneet. Rock asphalt is being laid in New Haven, Conn., which requires no binder, but C. W. Kelly, City Engineer, says that by all means a binder should be used when Trinidad asphalt is used.

Horace Andrews, City Engineer, Albany, N. Y., says that the city has built no asphalt pavement for several years, but the pavements they have were laid with a binder coat of bituminous concrete of about one and three-fourths inches in thickness.

Edward B. Guthrie, Chief Engineer, Buffalo, N. Y., says: "It is not the custom to use a binder coat where Trinidad asphalt is used."

C. L. Johnston, Utica, N. Y.—"Most of our asphalt pavements in this city have been laid with a two-and-a-half-inch surface coat without a binder. I have, however, come to the conclusion that a binder coat is preferable and in all of the plans which have been made by me this year I have designated a one-inch binder and a two-inch surface coat."

PAVING BY DAY'S LABOR IN WASHINGTON.

Criticism was made recently of the paving department in Washington, D. C., by the Central Labor Union in a letter addressed to the commissioners asking for an investigation of certain work done in the street paving department, in which it was alleged that a contractor had a contract for paving, part of which was done by the district day laborers. The Union further alleges that the commissioners have no right to enter into paving contracts for less than $1,000; that a piece of work costing less than $1,000 should be done by district day laborers at Union rates. Regarding the first complaint, the commissioners say that it is true that day laborers were put on the work because they were not satisfied with the contractor's work, and the contractors did not get paid for the work done by the day laborers. Also, that they have the authority to enter into paving contracts for less than $1,000, and that it is frequently for the best interests of the government that they do so.

A PLAN FOR OVERCOMING OPPOSITION TO PAVING IN CLEVELAND.

The plan that is in operation in Cleveland, O., for paving streets, which provides that property-owners shall pay for pavements according to their frontage, is proving detrimental to the city's progress in needed improvements. A proposition to pave a street is met with combined opposition on the part of the property-owners, which baffles the city administration in its efforts to pave the streets.

One means is offered, however, for bringing the property-owners to time, which is looked on with favor. The city expends about $40,000 a year for cleaning paved streets, and about $150,000 a year in caring for unpaved streets, which consists in rounding up roadways, repairing cross walks and catch basins, and filling up holes, and as these repairs are but temporary they all have to be done over each year. The plan suggested as a

remedy is for the city government to devote $190,000 now used for all purposes of maintaining the roadways, except so much as is necessary to clean and repair catch basins, upon the paved streets, and let those who do not or cannot pave their streets get along in the best way they can, while the city keeps the paved streets in good repair and well cleaned. A year or two of this will result, it is thought, in many pavements being put down which are kept back by property-owners. The use of the larger part of $150,000 in an attempt to keep unpaved streets in repair, and only $40,000 for paved streets, which can be used most, is looked on as unfair to those who have paved their streets, and to the general public.

THE TEN-YEAR ASSESSMENT PLAN FOR PUBLIC IMPROVEMENTS.

The plan in vogue in Indianapolis, Ind., Buffalo, N. Y., and other cities of special assessments for street improvements, being made payable in ten annual installments, instead of imposing the entire cost of improvement on the property-owners at one assessment, is contemplated at St. Louis, Mo. The Real Estate Exchange, which recommends amending the laws relating to the assessment and collection of special taxes, hopes to secure in this way the more rapid improvement of streets in the outlying sections of the city, and at the same time to avoid imposing heavy special taxes on the owners of abutting property.

CONVICT LABOR ON STREETS IN NEW YORK.

The convict labor problem for street work is under consideration at Brooklyn, N. Y. The law requires that the labor of convicts shall be either for the production of supplies for the state or any political division thereof, or for the purpose of industrial training and instruction, or partly for one and partly for the other. A special clause authorizes the employment of convicts in the work of keeping the street clean, grading and paving, putting in sewers and water pipes, opening new streets, and other work of a public character. This is the clause under which it is proposed to put convict labor to work. Restrictive laws have been passed under which, after Jan. 1, 1897, they will not be permitted to work for contractors, and the sale of goods manufactured by them is prohibited in so far as these goods may compete with the products of free labor. These laws were passed at the instigation of organized labor.

REMOVAL OF BRIDGE AT ASHTABULA.

The recent decision of Col. Smith and the Secretary of War in ordering the swing bridge across the Ashtabula river removed to the opposite side of the river was a great surprise to the citizens of Ashtabula, O. The bridge crosses the river at a point where there is an acute curve; the abutment on one side extends some distance into the river and the pivot on which the bridge swings is close to the opposite shore, while the bridge protection extends a distance into the river at either end, which gives the effect of its being almost impossible for large boats to pass without danger and great difficulty. While it is admitted that the bridge is in a bad place, yet boats have found no difficulty in passing through the draw. The bridge is under the jurisdiction of the board of county commissioners, who claim that they are tied up by state laws and have not the money with which to make the improvements, and as orders have been given that the work be done at once, fears are entertained that the bridge will be taken up and laid on the shore.

STREET CLEANING IN EUROPEAN CITIES.

Methods of street cleaning in European cities were given some attention by George E. Waring, jr., Commissioner of Street Cleaning in New York City, while on a European tour this summer. With this object in view he visited Munich, Budapest, Vienna, Berlin, Hanover, Cologne, Brussels, London, Paris, Turin and Birmingham, of which he says:

"In all these cities I made a complete investigation of the systems of street cleaning. All the cities are well paved and in most of them the streets are kept in good condition.

"Strange to say, Cologne, that city of memorable smells, was the cleanest large town that I visited. For years Cologne has had a bad reputation for dirty streets and poor sewerage, and I was much surprised to find it the direct opposite of all this. It is by far the best cleaned city that I entered.

"After Cologne came Turin. It, too, has a most complete system of street inspection, and I was able to pick up a number of details there that may stand me in good stead some day. Birmingham was another clean city. There they

have an extensive crematory system which allows them to burn all their refuse.

"The system is a most excellent one, but it could not be used here, as our coal is not suited for the work. The coal they use leaves very little ash and contains a constituent not found in our fuel.

"The wages of the men employed on the streets are everywhere lower than in New York. While most of these cities have good systems, they are not much, if any, in advance of New York, and during all my time abroad I saw nothing that would lead me to make any extensive changes in the system that has been inaugurated here. I expect to start to work again in a few days, and while there may be a few unimportant changes, the street cleaning as a whole will be conducted on the old lines."

COST OF ASPHALT PAVEMENTS IN BROOKLYN.

In reply to an inquiry from the editor of the Brooklyn Eagle, under date of Oct. 1, asking for information as to the highest and lowest prices paid by the city for asphalt pavement, N. P. Lewis, Engineer of Street Construction and Maintenance, said:

"Of contracts made this year the highest price for asphalt pavement on streets containing no car tracks was $1.20 while on streets having car tracks, such as Greene avenue, from Classon to Franklin, it was $1.40, and on Gates avenue, from Bushwick to Ralph, $1.50.

"The lowest prices for which work has been let is $1 a square yard for the wearing surface. To both of the above figures should be added about 65 cents a square yard for concrete foundation.

"The price for new curb varies from 75 cents a running foot on asphalt streets, where the work is done with special care, to 65 cents on some of the new streets.

"The prices for flagging during the last year have ranged from 15½ cents to 24 cents per square foot; while that for relaying old flags has varied from 2 cents to 5 cents per square foot.

"The price of asphalt pavement, as you know, two years ago was about $2 a square yard for the wearing surface alone laid over old stone pavement, while on Ninth avenue, from Union to Third streets, and on Dean street, from Nevins street to Fourth avenue, which were the first pavements laid with an asphalt binder, instead of coal tar, the price was $2.28 per square yard.

LIABILITY FOR INSUFFICIENT WATER PRESSURE.

In a suit against the Owego Water Works Company, Owego, N. Y., to recover the value of his works, which were destroyed by a fire that was communicated from an adjoining building, Joel A. Hamilton was given a judgment, Oct. 15, for $6,500. Mr. Hamilton claimed that the spread of the fire was due to insufficient pressure, and the court held that the lack of pressure was due to negligence on the part of the water company.

DAMAGE TO PAVEMENTS BY FIRES.

Superintendent J. C. Mundy, Newark, N. J., has warned the citizens to not violate the ordinances by building fires on either asphalt or brick paved streets. He says: "Fires of any description made upon streets paved with either asphalt or brick are very injurious to the pavement and the damage is costly to repair. As frequent complaints are made to me of such practices. I am determined to put a stop to them."

LIABILITY ON DEPOSITS FOR WATER METERS.

Suit was brought recently in Des Moines, Ia., for the recovery, from the water company of the sum deposited for a meter, but the case was not permitted to go to trial, as the company settled by refunding the sum deposited for the meter, and paying the costs of the suit. The plaintiff in the case deposited, two years ago, $15 for a meter, but found that it would be to his advantage to have a house rating instead of the meter rating; he requested the company to take the meter back and give him a house rating as desired; also, that the $15 be refunded to him. The company refused, he alleges, to take the meter out, or to accede to any requests; he then asked in writing that the meter be taken out and the water shut off, but after waiting a sufficient time for compliance he began suit in Justice Blake's court for $15, less 50 cents meter rental, for the month of September. This resulted in a prompt settlement on the part of the company, which paid $14.50, the sum demanded, together with costs.

RIGHT OF MUNICIPALITIES TO CONSTRUCT COMPETING WATER WORKS.

The Supreme Court of Pennsylvania reversed itself, Oct. 6, in a former decision made on the borough water works question, which gains for private water companies a sweeping victory. In the cases of J. T. White and others against the City of Meadville, and Martin Metzger against the Borough of Beaver Falls, it is held that a municipality cannot build wa-

ter works of its own if the town is being supplied by a private corporation; its only recourse is to buy the plant of the private company. This decision puts in force the law contemplated by the Wood's water bill, which was passed by the legislature, but vetoed by Governor Hastings and which provided "that municipalities could not build water works of their own if private companies were supplying the town, but they must purchase the private plant." In the opinion handed down by Justice Dean he admits that the Supreme Court made a mistake in its ruling in the Millvaleborough water works case, and reverses the ruling in it also. The ruling was that a municipal body is clothed with powers of legislation to a limited extent, and when within the limits of its authority its acts are obligatory; in the contract with the private company no restriction was placed on the borough's right to erect a water works plant in the future; that is a right, it was held, given to all such bodies by the law, and they may exercise it, no matter at what cost to private companies whose franchises are held subject to such right; the right of a borough to erect water works is independent of the right of private corporations to erect similar works, and it is of no consequence that such erection will injure private franchises of the same character. The ruling is now reversed. Justice Dean, in referring to this case, says: "It was a mistake. We now are glad of the opportunity for correction, especially so because the example of Millvale borough seems to have led other municipal corporations to adopt the same course of action."

A permanent injunction was granted against the city in conclusion restraining it from entering into a contract for the construction of water works.

The hearing of the appeals which were taken by the town of Westerly, R. I., from the decision of the Circuit Court for Rhode Island, was begun in the United States Circuit Court at Boston, Oct. 7, with Judges Colt, Nelson and Webb sitting. The facts relating to the suit are: The water company was given the right in 1885, by a vote of the town, to lay and maintain its pipes on the streets of the town, and to supply the town with water for twenty-five years. It was subsequently granted a charter by the Rhode Island Legislature, its franchise embodying the privileges which it obtained previously by the vote of the town; in 1891 the town, in pursuance of a town vote, notified the water company that it desired to buy its works, and repeated attempts were made to agree upon arbitrators who were to determine the price to be paid, but each attempt was unsuccessful; the town finally voted, April 11, 1895, to give the water company thirty days to agree upon the arbitrators, and if at the end of that time the arbitrators were not agreed upon to appropriate $500,000 for the construction of a water works system of its own; then the water company and the Seamen's Friend Society, which holds some mortgage bonds of the water company, brought bills in equity and asked the court to enjoin the town from proceeding with the awarding of contracts for and the construction of a new system of water works; the plaintiffs made a motion for a preliminary injunction, claiming that the town after granting a franchise to the company for twenty-five years, which franchise has not expired, had no right to enter into competition with it, and also had no right to do anything to impair the company's contract with it. The granting of this motion is the cause of the appeal made by the town.

STREET IMPROVEMENT ASSESSMENTS REFUNDED IN TEXAS.

The Supreme Court of Texas has refused to grant a writ of error in the case of W. L. Prather vs. the city of Waco, which involved about $250,000 in special taxes for street improvements assessed against a large number of abutting property-owners on many miles of paved streets. This places the entire tax for street improvements on the taxpayers of the city at large. The point on which the case was lost is that the contracts were awarded on the report of the street committee by adopting the same on motion of an alderman, seconded, and neither resolution nor ordinance stands on record to warrant such awards of contract. It will now be necessary for the city to reimburse these abutting owners who paid the special tax before the resistance offered by Col. Prather caused a general stopping of the collection of the street improvement tax. The money to be refunded will amount to more than $20,000.

TESTS OF PAVING BRICK AT DAVENPORT, IA.

The tests of paving brick up to the present time in Davenport, Ia., have resulted as follows:

Test 1—Purington brick, Locust street. Absorption test, highest per cent., 3.52; lowest, 2.43. Abrasion test showed 5.26 and 4.65 per cent.

Test 2—Locust street, from Tremont avenue to Ida avenue, the same brick showed 2.87 and 2.39 on the obsorption test and 4.68 and 3.53 on the abrasion test.

Test 3—Des Moines brick used in repair work on the streets, showed a per cent. of 1.35 and 1.02 on absorption and 5.73 and 5.66 on the abrasion test.

Test 4—Purington brick on Sixteenth streets, between Grand and Arlington avenues, showed 3.12 and 2.61 on the absorption test and 4.73 and 4.73 on the abrasion test.

Test 5—Des Moines brick used in another series of repairs showed the following result: Absorption, 1.70 and 1.25; abrasion, 7.90 and 6.28.

Test 6—Sample of Davenport brick, showed 4.20 and 2.40 on the absorption test and 6.34 and 6.29 on abrasion.

Test 7—Purington brick, used in Le Claire street, between Sixteenth and Locust, showed 3.82 and 2.45 by absorption and 6.25 and 5.23 by an abrasion test.

The city authorities are about to make another series of tests.

IMPROVEMENTS IN INDIANAPOLIS.

A table showing the improvements in Indianapolis during 1896 and 1895 has been compiled by City Engineer Jeup and is as follows:

	1895. Sq. Yds.	1896. Sq. Yds.
Asphalt	168,328.36	87,630.74
Brick	39,058.50	43,247.09
Wooden block	44,557.70	79,432.97
Macadam	18,416.50	22,301.00
	Lin. Ft.	Lin. Ft.
Gravel sts. and alleys	18,966.10	57,812.67
Cement sidewalks	62,126.54	129,564.11
Brick sidewalks	15,100.70	20,637.50
Sewers	84,475.85	83,724.80
Bridges, etc	$12,784.75	$15,594.13

LIMESTONE IN CONCRETE.

To the Editor of Municipal Engineering:

In your issue of this month, on page 227, in an article entitled "Trap Rock in Concrete," you state "that one kind of stone is as good as another for concrete."

The experience of many engineers, architects and departments in this vicinity has been exactly the contrary. Limestone has been condemned here by the Department of Docks of the city of New York, by the United States government at the Brooklyn navy yard and by many of the engineer officers in charge of the different government posts in this vicinity on account of its inferiority and liability to "slack" and "disintegrate." It is claimed by many that limestone is seriously affected by the acids in Portland cement, and by some engineers and architects that it will disintegrate by the action of the weather also.

It is a question which has been discussed here for many years, and I think it would be well if opinions would be published, giving reasons on both sides. Hoping you will find space to publish this in your valuable monthly, I remain yours truly, JOHN J. DONOVAN.

New York, Oct. 22.

PERSONAL.

Walter A. Doane has been elected City Engineer at Meadville, Pa.

C. S. Sherwood has been elected president of the City Council at Portsmouth, Va.

J. Calvin Locke has been appointed Assistant Sanitary Engineer at Brooklyn, N. Y.

M. V. Dolan and E. F. Yorke have been appointed sewer inspectors at Albany, N. Y.

David Lynch has been appointed inspector of the Providence avenue sewer at Chester, Pa.

Eugene Hanna has been appointed Superintendent of the Water Works Company at Watervliet, N. Y.

George Chambers, a prominent contractor in Municipal work of Chicago, Ill., died Oct. 15, aged seventy-two.

George O. Viebahn has resigned his position as City Engineer of Watertown, Wis., to take up the study of law.

Albert S. Noyes, a member of the Metropolitan Sewer Commission, Boston, Mass., died suddenly in that city Oct. 12.

F. A. Dunham, C. E., Plainfield, N. J., has been engaged to furnish complete maps of that brough, comprising five sections.

Maj. B. M. Harrod, M. Am. Soc. C. E., has been appointed Chief Engineer of the proposed drainage system at New Orleans, La.

H. H. Havill has been appointed engineer of sewage purification in the Twenty-sixth ward purification works, Brooklyn, N. Y.

Daniel Moran, William Taylor, Henry Baltzel, D. S. Chamberlain and S. B. Gavitt have been appointed members of a new sewer commission at Lyons, N. Y.

E. S. Shaw, C. E., Boston, Mass., was awarded the $10,000 prize offered by the Montreal Bridge Company, for the best plan for a new bridge from the city to the south shore.

Dr. B. Meade Bolton of the Bacteriological Labortory of the Bureau of Health, Philadelphia, Pa., has been appointed Professor of Bacteriology in the University of Missouri, Columbia, Mo.

Palmer H. Baermann, a graduate of the Renssalear Polytechnic Institute, and formerly City Engineer and Engineer of Public Improvement at Troy, N. Y., has been declared insane and removed to an asylum.

P. J. McWeeny has been appointed Deputy Superintendent of Public Works of the New York State Department of Public Works, Albany, N. Y., and, in the absence of Superintendent Aldridge, will perform his duties.

Dr. T. M. Browne, president of Le High University, Bethlehem, Pa., and Samuel M. Gray, Engineer of Providence, R. I., have been retained by Frederick A. McClure, City Engineer at Worcester, Mass., as experts to study the sewage disposal problem in that city.

John W. Hill, Cincinnati, O., and George H. Benzenberg, Milwaukee, Wis., have been selected by Mayor Swift of Chicago, Ill., as two of the three experts authorized by the special council committee to investigate the matter of building intercepting sewers.

Newcomd Carleton, Hydraulic Engineer, Buffalo, N. Y., has been appointed to conduct the tests on the new 30,000,000 gallon pumping engine and the new boilers. George H. Barrus of Boston will be associated with him.

William Bull, William Flanagan, Henry Patten, A. DeFerrier Loomis, John Murfit and Charles A. Hunt have been appointed sewer inspectors by the Board of Sewer Commissioners to superintend the work of constructing the laterel sewers at Nneida, N. Y.

At a meeting of the Chamber of Commerce, Oct. 20, the park and boulevard system of Cleveland, O., was discussed and addresses made on "Men Who Make Our Parks and Boulevards Possible," by Mr. Harry G. Goulder, and "Educational Influences of Parks," by Mr. Charles W. Thwing.

Dr. J. H. McClelland of the Pittsburg Pure Water Commission will address the State Board of Health on water systems at the November meeting. Dr. McClelland, who made a recent tour of inspection through Europe; and after an investigation of the transatlantic water plants affirms that with their system introduced in this country, thousands of lives would be saved annually.

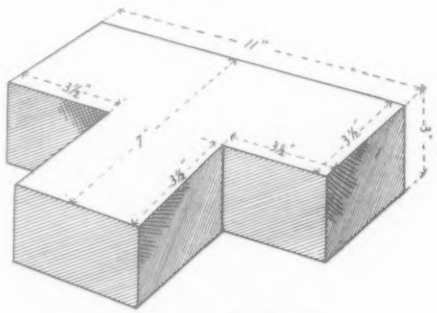
MACHINERY AND TRADE.

A NEW KIND OF PAVING BRICK.

Recent tests have been made at the shops of the American Clay Working Machinery Company, Bucyrus, O., of a process for making paving brick and fire proofing of material largely composed of common coal ashes, with the addition of a few chemicals. No burning is required and five hours after being made it is claimed that the bricks are ready for use. George W. Averill of New York is the patentee, and William Wirt Chapman of New York represents a stock company interested in the experiments and tests. The company figures that it will require eleven plants to take care of the waste ashes of New York City alone, and that the eleven plants kept running constantly would not be able to utilize all of the material. Manufacturers will also be equipped in other large cities. The ashes used are either of hard or soft coal; marble dust can also be used to good advantage.

A LOCK JOINT PAVING BLOCK.

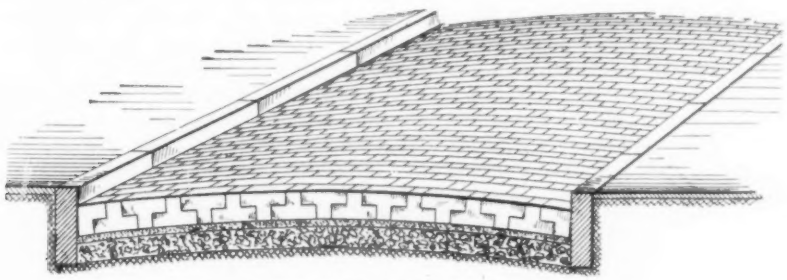
Among the various novel forms of paving blocks is one invented by George E. Briggs of Pittsburg. Patents were secured on it in this country and England



A LOCK JOINT BLOCK.

in 1892, and a company was organized to put it on the market, but operations were delayed by the depression which soon followed. During the last few months

favorable consideration of it has been secured in Europe. Mr. Briggs, the inventor, in a letter to Muncipal Engineering, states that eight contracts for the use of the device have been closed in England, Wales and Ireland, and he says that in a few weeks four firms will be engaged in manufacturing it. American manufacturers have been slow to adopt it, though the inventor has received encouragement from architects and engineers. It is claimed for the paving block, an illustration of which appears in connection with this article, that the lock joint affords advantages in bonding and that the strain is widely distributed. Two blocks (the top of one and the stem of the next) have a wearing surface of 45 square inches. The wearing surface of two common bricks of ½x2¼x4 inches, laid edgewise, is 38¼ inches. Fifty-eight



A LOCK JOINT BRICK PAVEMENT.

blocks equal 106 common brick in two courses. The inventor says that the cost of making one of the lock joint blocks is approximately one and one-half times that of making one common brick, or 58 blocks will equal 87 common brick, but he claims that as 106 of the latter are required for one square yard there is a gain of 18 per cent. in favor of the block.

A later letter from Mr. Briggs, under date of October 23, says: "Up to October 14 a total of twelve contracts have been made with leading British firms, covering fifteen counties in Ireland, ten in England and four in Wales. Prof. Unwin is much interested and has brought our brick and block to the attention of the scientific department of the Royal British Institute of Architects."

TRADE NOTES.

F. M. Lesher & Son, sewer contractors of Easton, Pa., have failed.

The purchase of a stone crusher was advised recently at Cambridge, Mass.

The Iowa Engineering Society, Des Moines, Ia., has filed articles of incorporation.

Heckard & Sons, Canton, Ill., have closed down their paving brick works for a short time.

The Eclipse Paving Brick Works at Doughton, O., have been leased by D. R. Shiras, of Sharon.

The City Council, Dover, N. H., has purchased a new steam roller of the O. S. Kelly Company.

Newman Brothers, paving brick and tile manufacturers, Des Moines, Ia., are financially embarrassed.

The Hancock Bridge Company, Hagerstown, Md., has elected the following directors and officers: President, J. F. Fields; secretary and treasurer, E. P. Cohill; directors, C. E. Ways of Baltimore and P. E. Dawson and Robert Bridges.

The City Council, Tampa, Fla., contemplates the purchase of a stone crusher and a steam road roller.

The purchase of a rock crusher is contemplated at Lynchburg, Va. Lafayette P. Rodes, City Engineer.

The street and alley committee of the council, Creston, Ia., has been authorized to purchase a new road grader.

The selectmen at Danbury, Conn., have been authorized to purchase a portable stone crusher.

J. C. MacNamara & Co. of San Antonio, Tex., are shipping 2,000 tons of rock asphalt to Troy, N. Y., for use in street paving.

The Rogers Construction Company of Tonawanda, N. Y., has made an assignment. John F. Burke has been appointed receiver.

The City Council at Greenville, O., has leased a steam road roller from the Aultman Company, Canton, O., for $800 a year, with the privilege of purchasing for $2,400 in three annual payments.

The Galesburg Paving Brick Company, Galesburg, Ill., has the contract for furnishing brick for paving the country road at Monmouth, Ill.

The McHose & Lyon company, manufacturers of bridges and heavy castings, Dayton, O., made an assignment to Eugene Winchet, Oct. 6.

The Kankakee River Improvement Company, Laporte, Ind., has been incorporated to improve the channel of the Kankakee river and tributaries.

The City Clerk, Merrill, Wis., has been instructed to advertise for bids for a steam road roller and a stone crusher, the bids to be in by December 1.

An ordinance is before the City Council, Oakland, Cal., for the purchase of a 15-ton steam road roller. Street Superintendent Miller has charge of the matter.

The Pacific Coast Portland Cement Company has been incorporated at Vancouver, B. C., by J. C. Ferguson, C. W. S. Robson, H. J. Warsap and T. R Hardman.

The Council at Harrisville, R. I., held a town meeting, Oct. 7, to consider the question of purchasing a stone crusher, engine, boiler, road roller and road machine.

Messrs. Trask, Meader and Kimball have been appointed a committee at Rochester, N. H., to purchase a steam road roller, for which $2,000 has been appropriated.

The Telluride Sewerage Company was incorporated Sept. 24 by Arthur M. Reed, H. H. Daniels and A. E. Patterson, to construct a sewage system in the city of Telluride, Col.

The J. W. Wilding Company has been incorporated at Ft. Wayne, Ind., to manufacture a cement and paving material by James W. Wilding, Ella E. Wilding and Cordelia A. Wilding.

The Street Sweeping and Loading Machine Company, 2520 Bismarck stareet, St. Louis, Mo., has been organized to handle the patents owned by Henry Mueller, jr., and to sell the Mueller street sweeping and loading machines.

The Globe Stone Company, Cleveland, O., has been incorporated to operate stone quarries and manufacture brick and tile. Messrs. J. F. Harper, Frank Bradley and Tyron Bailey of Chagrin Falls, O., are the incorporators.

The Common Council committee on street lights, Milwaukee, Wis., decided recently to report in favor of a new contract with the Milwaukee Gas Light Company for lighting the streets with gas for a term of five years, at $20 a year per lamp.

The Elmira Heights Water Company has filed a certificate of incorporation. The directors of the company are: Howard H. Hallock, Elmira; Walter Hawxhurst, Mt. Vernon; James R. Rathbone, Jesse L. Cooley, John A. Reynolds, Antonio Romer and William W. Cole, Elmira.

C. G. Carlson, City Clerk at Moline, Ill., says that the city has purchased one 15-ton Columbian steam road roller of the Aultman Company, Canton, O. Mr Carlson says the roller has been received, set up, tried and accepted by the city, is now operated every day, and so far has proven success.

The Purington Paving Brick Company, Galesburg, Ill., is shipping large orders of brick to Peoria, Chicago, Beloit, East St. Louis and St. Paul. The brick sent to Peoria are being used for paving between the tracks. The contract with St. Louis calls for 1,500,000 brick. The company alone has a big contract for furnishing brick for street paving at Macomb, Ill.

Walker & Robinson, Tippecanoe, O., who have the contract for constructing the sewerage system at Geneva, N. Y., made an assignment Oct. 3 to the American Surety company, of New York, on bonds as security for the payment of wages to the amount of $15,000. About nine miles of the sewers have been completed, and about thirteen miles are yet to be laid.

The mines of the Alcatraz Asphalt Company, in Santa Barbara county, Cal., have been purchased by the South African syndicate for $2,000,000, for which price the syndicate secures three great beds of asphalt, one of which produces asphaltum 95 per cent. pure, and another, known as the Sisquoe grant, is estimated to contain 100,000,000 tons of crude asphalt. The purchase is one of the largest mining deals on record in the state of California.

Suit has been brought in the United States Circuit Court at Utica, N. Y., by the New York Filter Manufacturing Company, 145 Broadway, New York, against the Elmira Water Works Company for infringement of the Hyatt patent, dated Feb. 19, 1884. The suit is the result of a contract given recently by the Elmira Water Works Company to the Morrison-Jewell Filtration Company of New York and Philadelphia for the erection of filter plants. Application to the court for an injunction will follow.

SELECTIONS FROM THE PRESS.

A BRIGHT, CLEAN, CHEERY TOWN.

The city of Indianapolis is a place that will be heard from in the near future. Those who attended the sound money convention there are the men whose good opinion is worth something, and every one of them will have something pleasant to say of Indianapolis. It's a bright, clean, cheery town. There's room in it. The eye can rove around and get a rest. Taking in the perspective of its streets one gets over the cramped, crushed, crowded feeling that oppresses in larger towns. It is considerably more than the residence of Benjamin Harrison, the best two-minute talker on earth. It has a better book store and larger publication house than St. Louis possesses, and it would be a great boon if we could have some genial genii change the street commissioners of the two cities in their beds some night and give poor old St. Louis a chance. Indianapolis has a monument that conveys an idea. The town would be rememberable for its column "to the silent victors" if for nothing else. It dominates the town, and the ideas that such a structure evokes are, I think, a very good thing to dominate a town. This monument is a strong, severe, bold and eloquent effort at commemoration. That it is composite may be a fault with finics who are cynics, but there is no fault with the patriotic thrill the bronze and stone convey to one who looks upon its rigorous majesty. It is a very vivid memorial. The town of Indianapolis is all right, and it is going to be, eventually, a much larger town. It is now more metropolitan in some things than St. Louis.—From St. Louis Mirror.

ALL RIGHT AS A PAVING MATERIAL.

The manner in which one of the men pawed the air and hammered the palm of his hand made it easy to guess the topic of conversation. Nothing save the financial question would so move a man. The other was no less in earnest, but his style of debate was different. His was the intensity of suppressed emotion. The horses hitched to their respective farm wagons looked around now and then with a homesick appeal in their eyes, but the ambition for the last word made the disputants forget that there were chores to do and supper to eat. As often happens when a discussion is too far prolonged, their arguments were occasionally more ingenious than relevant.

"It stan's ter reason," said the more excitable man, "that gold is the thing we want."

"It seems ter me," was the answer, "ter stan' just ez much ter reason thet silver is the thing we want."

"That ain't accordin' to common sense."

"Wal, I've got inter that notion, anyhow. I don't want no gold money."

"An' thet jis' shows ye ain't a proper person ter have a voice in the affairs o' this gover'ment. Ye're not only goin' agin' the teachin's of history an' the opinions of some o' the greatest financiers this er any other country hez perduced, but ye're showin' downright disrespeck to the scriptures."

"I ain't nothin' o' the kind."

"Yes, y'are, an' I kin prove it. Read the descriptions of the future state of happiness. Ain't it said thet the very streets 'ill be paved with gold?"

"Looky here, Thad Tuttle; don't ye git me riled. I'll stand patient while ye's call me an ignoramus an' a repudiationist an' an anarchist. Mebbe I'm wrong in my politics, ez most any man is li'bl. ter be. But don't ye accuse me o' backslidin'. I won't tolerate that, 'cause I don't deserve it. All I said about gold was as a money metal; I ain't got a thing agin' it as pavin' material."—Washington Star.

WOODEN PAVEMENT CONDEMNED IN NEW YORK.

The Australian wood pavement that was laid on W. Twentieth-st., between Broadway and Fifth avenue as an experiment a year ago, has proven a failure. The pavement was laid with a view to getting the city to adopt it on certain thoroughfares where the traffic was not particularly heavy.

The Commissioner of Public Works has had considerable trouble with it, and numerous complaints have been made by drivers of vehicles. In rainy weather the horses driven over this pavement would slip, and the Commissioner of Public Works has had to sprinkle sand over it in order to avoid serious accidents.—New York Herald.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

Savannah, Ga.—Work has been resumed in placing the curbing on South Broad street.

Kansas City, Mo.—The Gilson Asphaltum Company contemplates laying Indian Territory asphalt on Walnut street, between Eighteenth and Nineteenth treets.

Atlanta, Ga.—The Finance Committee rejected all the bids received Oct. 13 for the $130,000 of 4½ per cent. paving bonds because they were unsatisfactory.

Reading, Pa.—An ordinance has been presented repealing the ordinance authorizing the issue of $100,000 bonds for the paving of Penn street, from Front to Eleventh.

Syracuse, N. Y.—The failure of this city to float the $220,000 of local improvement bonds has been the cause of G. D. Grannis & Company discontinuing the work of paving Cortland avenue.

Williamsport, Pa.—The Sicilian Asphalt Paving Company has instituted suit against the Williamsport Passenger Railway Company to recover the company's share for the paving of W. Third street.

Lowell, Mass.—The Good Roads League was organized Sept. 30 to urge the extension of good roads. The officers are as follows: President, T. P. Hall; vice-president, C. H. Conant; secretary and treasurer, George H. Stevens.

Brooklyn, N. Y.—Theodore B. Willis, commissioner of city works, has called the attention of the police department to an enforcement of the ordinance against the building of fires on the public streets, particularly on asphalt streets.

Albany, N. Y.—More miles of pavement have been laid in this city this year than in any previous year. The longest strip is the brick pavement in Central avenue, from Main avenue to Knox street, and the smallest strip is the brick pavement in St. Ann's Place.

Omaha, Neb.—In accordance with resolutions that all streets on which the guarantee expires in 1897 be put in first-class shape, Chairman Munro of the board of public works, has notified the paving companies to put the streets in acceptable condition.

Lima, O.—A petition was presented to the council several months ago by the property-owners on W. Spring street, asking it to pass a resolution authorizing them to pave the street, but the council refuses to pass the ordinance, much to the disappointment of the petitioners. There is not a paved street in the city, and the action of the council in thus retarding improvement and progress is causing dissatisfaction.

New York, N. Y.—The bond of the Barber Asphalt Paving Company for paving Fifth avenue with asphalt was approved Sept. 28. This contract was first awarded to the California Asphalt Company, which sub-let it to the Barber Asphalt Company at the same figure it bid for the work, $328,000.

Newark, N. J.—The report of the Municipal Committees show that during the last year 3.07 miles of asphalt, .92 mile of brick and 2.49 miles of granite paving have been laid at an expenditure of $353,529, and 7.87 miles are in the course of construction, the cost of which will be $333,135.

Omaha, Neb.—Judge Powell refused to grant an injunction restraining this city from contracting with John Grant for repairing asphalt streets. The cotract covers forty paved districts, aggregating 200,000 square yards, and is for five years, and the price ranges from 98 cents to $1.10 a square yard for repairs actually made.

Jersey City, N. J.—Application has been made by the school authorities to have the block on the Brunswick street side and the half block on the Wayne street side of School No. 9 paved with asphalt. The classes are obliged to suspend recitation when trucks pass over the present Belgian block pavement. Mercer street, on the south side of the school, is already paved with asphalt.

Indianapolis, Ind.—Street paving has been completed as follows: Asphalt, Vermont street, from Meridian to Pennsylvania, $6.04 a lineal foot or $5,035.16. Walnut street, from Capitol avenue to Senate avenue, $2.69 a lineal foot or $2,184. Brick, Maryland street, from Kentucky avenue to West street, $5.20 a lineal foot or $12,797.13. Court street, from Senate avenue to California street, $2.75 a lineal foot or $6,627.86.

New York, N. Y.—The pavement on the east side of New street, between Wall street and Exchange Place, has sunk fully six inches below its original level for a distance of about fifty feet. The asphalt pavement has in some places entirely fallen away, leaving deep fissures. It is thought that the street has been undermined by the workmen in excavating for the cellar for the Cable building, in front of which the pavement has sunk.

Westminster, Mass.—The Massachusetts State Highway Commission has annulled this town's contract to construct the Westminster state road because of the action of the town authorities in employing laborers not citizens of this state after being notified that the employment of these people would be illegal. At a meeting of the commission at Boston the contract was re-let and in no case will another bid on the part of the town be considered.

Boxborough, Mass.—The will of the late Peter Whitcomb bequeaths to this town $5,000 to be expended under the direction of the selectmen or road commissioners for the maintenance, repairs and improvements of the roads and bridges. The town is to appoint some suitable person to receive the sum from the executor of the will and to invest it as the Peter Whitcomb fund, and the town is to annually, at the town meeting, appoint some suitable person to collect the interest thereof and to pay over to the treasurer of the town the interest and the income.

New York, N. Y.—The Public Works Department is importing Belgian blocks; 15,000 have been received. E. P. North, Water Purveyor, says of them: "The blocks are of a peculiar stone found only in Belgium. The stone has no grain such as our granite has, and the blocks are more durable than any we have here. The stone is of a queer formation, due, it is said, to ancient volcanic disturbances. The blocks, cut, come direct to us from Belgium. They will be used in West street, Broadway and Canal street, where the heaviest trucking is."

New Haven, Conn.—Owing to the lateness of the season J. E. Miles & Co., who have the contract for paving Wooster-st. with brick, objected to beginning the work this fall. A resolution was adopted, however, Oct. 5, that the contractor shall work until Dec. 1 and then discontinue work until April 30, 1897, when he can begin again. A resolution was also adopted in the shape of an amendment to the contracts with the Boston Asphalt Company specifying that for Trumbull street the price per yard for a pavement be stated at $2.97, and repairs .08 per yard; Orange street, $2.93 for pavement and .08 for repairs.

New Haven, Conn.—It has been found necessary to change the contracts which this city has with the Boston Asphalt Company for paving Orange, Trumbull and W. Chapel streets so that the city can collect assessments against property-owners. It will be remembered that at the time the contracts were awarded it was urged by the majority report of the committee on streets that the contract was against the best interests of the city, because the price included a ten-year guaranty, and obviously included a charge for maintenance. It was then urged that it was impossible to separate the charge for maintenance from the cost of actual construction and that the act by which authority to lay the pavement, levy assessments, etc. was gained expressly provided that assessments should be made for the cost of construction only.

CONTRACTS TO BE LET.

College Hill, O.—Bids are asked until Nov. 16 for the purchase of $5,653.44 street improvement bonds.

Terre Haute, Ind.—Sealed proposals will be received until Nov. 3 for grading, curbing and paving with screened gravel Center-st., from Second to Eighth-ave.; bond, $200. Charles H. Goodwin, City Clerk.

Brooklyn, N. Y.—Bids will be received until Nov. 2 for constructing a roadway of macadam and brick on Eastern Parkway extension.

Somerville, N. J.—Sealed proposals will be received until Nov. 7 for macadamizing as follows: Union-ave., 4¼ miles, deposit or certified check $1,000; Mountain-ave., in North Plainfield, 2¼ miles, $1,000. A. P. Sutphen, Clerk.

Toledo, O.—Sealed proposals will be received until Nov. 2 for paving John-st. with Harris pavers on sand foundation, and grading, curbing, draining, etc.; also paving alley between Huron and Superior-sts. with block or bricks on a concrete foundation. Bids will be received the same day for grading Wallbridge-ave. Lem. P. Harris, City Clerk.

CONTRACTS AWARDED.

Atlanta, Ga.—The contract for paving Whitehall street was awarded to A. W. Hammond.

East Newark, N. J.—The contract for improving Davis street has been awarded to John Cullin.

Ottawa, Ill.—Peter Boyle of this city secured the contract for Parking Ottawa avenue for $1,042.

Marietta, O.—The contract for 34,000 square yards of brick paving has been awarded to W. J. Berry of Bellaire, O.

Albany, N. Y.—The contract for paving Elk street with brick was awarded to Mulderry Bros. for $3,307.90 Sept. 28.

Renfrero, Ont., Canada.—J. Foley of Ottawa has the contract for laying a block of asphalt paving in this city.

Decatur, Ind.—The contract for paving Court street with brick has been awarded to Woods & Dorwin at $1.29 a square yard.

Port Huron, Mich.—The contract for paving Pine Grove avenue with cedar blocks has been awarded to B. D. Bartow for $12,274.

Scranton, Pa.—The contract for paving Wyoming avenue, between Linden and Mulberry street was awarded to Dunn Bros. at $2.23 a square yard.

Boston, Mass.—The Metropolitan Construction Company secured the contract, Oct. 6, for the construction of sec. 8 of the subway for $61,420.

Decatur, Ill.—Dempsey & Giblin of this city have been awarded the contract for paving Maryland and Front streets with brick at $1.47 a square yard.

Cleveland, O.—The contract for the Lower Driveway on the Doan Brook Boulevard was awarded recently to James B. McDonnell for $68,737.50.

Roseville, O.—(Special.)—The Roseville Brick and Terra Cotta Company has two contracts to fill this year of 500,000 vitrified paving blocks each.

Hammond, Ind.—The contract for constructing 6,300 lineal feet of macadam streets has been awarded to the Brownell Improvement Company, Chamber of Commerce Building, Chicago, at $2.95 a lineal foot for macadam and 20 cents a lineal foot for curb each side.

Stockton, N. J.—Frank A. Ward of Camden secured the contract for macadamizing Cooper avenue in this town and will commence work at once.

Rahway, N. J.—The contract for macadamizing the Roseville road, from St. George avenue to the New Jersey railroad, has been awarded to William Chamberlain.

Allegheny, Pa.—A. V. Purnell was awarded the contract Sept. 30 for grading Broadway, from Perrysville avenue to Clyde Street, Tenth ward, for $3,650.

Ironton, O.—Contracts for building sections of the Branch turnpike have been awarded to Harry Brown, J. J. Robinson, Edward Wolfe and Josiah Thompson.

New Haven, Conn.—The contract for building a Telford road on Maple avenue has been awarded to John S. Lane & Son of Meriden at $1.35 per lineal foot.

Galesburg, Ill.—J. B. McAuley secured the contract for paving North street. Brick manufactured by the Galesburg Brick and Terra Company will be used.

Buffalo, N. Y.—The contract for paving Hoffman Place, between Osborne and Hamilton streets, Black Rock, with asphalt, has been awarded to Michael Newell for $3,300.

Ottumwa, Ia.—The Ottumwa Brick and Construction Company was awarded the contract for paving in district No. 53 at $1.40 a square yard for brick paving and 52 cents a lineal foot for curbing.

Chicago, Ill.—Proposals have been received during October for paving a large number of streets with asphalt, brick and cedar blocks. The bids were ordered tabulated and will be awarded soon.

Allegheny, Pa.—A. V. Purnell secured contracts Oct. 14 for grading, paving and curbing as follows: Broadway, Tenth ward, $3,650; Overholt-st., $4,052.50; Fountain-st., $16,615.

Duluth, Minn.—The lowest bid presented Oct. 16 for the paving of the approach to the Duluth-Superior bridge was that of P. McDonnell, which was, with sandstone curb, $14,899; granite curb, $15,121.

Milwaukee, Wis.—The contract for paving Biddle-st., from Market to Broadway, with vitrified brick on a concrete foundation, was awarded, Oct. 7, to John O. Jones of Racine at $1.78 a square yard.

Alton, Ill.—David Ryan was awarded the contract Oct. 12 for paving an alley with North Alton brick at $1.16 per square yard. The other bidders were Jobet & Company, $1.47; W. Rutledge, $1.50; C. F. Dagenhardt, $1.68.

Duluth, Minn.—Contracts have been awarded for constructing the Miller Trunk road as follows: Section No. 4, Gulbrandson Bros., $6,716; No. 5, P. McDonnell, $6,450; No. 6, W. H. Randall, $5,215; No. 11, C. H. Chaffee, $4,997.

Hasbrouck Heights, N. J.—The contract for grading, macadamizing, curbing and guttering a public street in this borough has been awarded to Daniel Bowden of Plainfield, the work to be done under the supervision of F. A. Dunham, City Engineer of that city.

Akron, O.—Kent, Main and Perkins streets wills be paved by George B. Herring of Mansfield, O. Barberton block and Berea curb will be used.

Connellsville, Pa.—The contract for paving Water-st. with brick was awarded Oct. 8 to Bernard O'Connor at $1 a square yard. The work includes 1,600 cubic yards of excavation, 3,300 lineal feet of curbing and 3,700 square yards of paving.

Cleveland, O.—The county commissioners received twenty-four bids Oct. 14 for grading and draining the Bricksville road. Connell & McDowell presented the lowest bid, apparently. Brick paving will be laid in the spring.

Rochester, N. Y.—Bids received for the Mill-st. asphalt pavement and sewer are as follows: Rock Asphalt Pavement Company, $19,685; Warren-Scharf Asphalt Paving Company, $19,780.75; Rochester Vulcanite Paving Company, $19,977.90.

Merchantville, N. J.—D. P. Regant Bros. of Philadelphia secured the contract Oct. 6 for macadamizing 1,500 lineal feet of road at 16 cents a cubic yard for grading and 62½ cents for macadamizing. The curbing and guttering contemplated has been postponed.

Omaha, Neb.—F. H. Guanella & Company were awarded the contract Oct. 1 for a sixteen-foot, class A macadam roadway in Broadway. The contract calls for 5,866 cubic yards of crushed limestone in separate layers at $1.78½ a cubic yard; total, $10,471.

Newark, N. J.—The New Jersey Asphalt Company was awarded the contract Oct. 22 for asphalt paving as follows: Linden-st., from Halsey to Washington, $2.54 a square yard, or $2,995.95; Astor-st., $2.54 a square yard, or $14,850. The company was authorized to commence paving at once.

Schenectady, N. Y.—The Metropolitan Paving and Construction Company secured the contract, Sept. 29, for repaving Center street, between State and Hamilton street, at $2.69 a square yard; curbing, 93 cents a lineal foot; catch basins, $50; water trap, $8; sewer connections, 35 cents; lead pipes, 45 cents.

Newark, N. J.—The contract for paving the new Riverside drive, Arlington avenue, Erie Place, and the Old River road with telford was awarded Oct. 2 to Thomas A. O'Connor at 90 cents a running foot for one-half the work and 87 cents for the other half, the whole aggregating $8,150.80. The contract for High street was awarded to George Spottiswood at $1.48 per ton broken stone.

Council Bluffs, Ia.—E. A. Wickham was the lowest bidder for paving the alley between Bryant and Main streets, Oct. 20, at $1.43½ for Des Moines brick for top course, and Council Bluff brick for bottom course, and $1.29 for Council Bluff brick for both courses. The other bidders were: Frank Cooper, Des Moines brick for bottom, $1.48½; Council Bluffs brick for both courses, $1.36½; J. J. Hughes, Des Moines brick for top and Council Bluffs brick for bottom, $1.49; Council Bluffs brick for both courses, $1.34.

Schenectady, N. Y.—The contract for paving Liberty street with asphalt was awarded, Oct. 6, to the Metropolitan Paving and Construction Company at the following prices: Paving, $2.69 a square yard; curbing, 89 cents per lineal foot; catch basin, $3.50; water trap, 88 cents; sewer connection, 35 cents; lead pipe, 45 cents.

Niles, O.—(Special.)—J. L. McDermott, City Clerk, says that the council rejected all of the bids received, Oct. 15, for paving Main street with asphalt blocks, except that of Davis & Caldwell of Youngstown, O., which they held for further investigation. The contract has since been awarded to Davis & Caldwell at $1.93 a square yard.

Scottdale, Pa.—The street paving contract was awarded to Bennet & Co. of Greensburg at the following prices: Excavating, 30 cents a cubic yard; curbing and crossings, 45 cents per lineal foot; paving, $1.29 a square yard. Empire brick will be used. The foundation will consist of eight inches of stone, two inches of gravel and one inch of sand.

Boston, Mass.—Bids were opened Oct. 16 for macadamizing Boylston street, from Boylston road to Brookline avenue. The bids offered were: P. O'Leary, $9,360; M. J. O'Hara and F. F. Finneran, $9,287; Collins & Ham, $9,406; N. McBride, $8,680; H. Gore & Co., $10,762; W. Scollins, $8,795; Jones & Meehan, $10,189; Dougherty & Conners, $9,541.

Boston, Mass.—Bids have been received by the State Highway Commissioners for macadamizing a road in Townsend as follows: Stuart & Son, Newton, $4,344; Duncan Rush, Boston, $5,000; A. J. Wellington, Boston, $5,052; Fred R. Page, Boston, $5,534; Fred E. Ellis, Melrose, $4,051; Davis Scanlon, West Medford, $5,343; F. T. Ley & Co., Springfield, $5,608.

Brooklyn, N. Y.—The contract was awarded Oct. 7 to Cranford & Company for repairing with asphalt on a concrete foundation, that part of McDonough street between Throop and Tompkins avenue at $1.25 a square yard. As an experiment this street was paved several months since with vitrified brick, but the residents complained of the roaring noise.

Macomb, Ill.—The contract for paving Lafayette, Randolph, Carroll and Calhoun streets was awarded to A. E. Rutledge of Rockford as follows: Excavating, 23 cents a cubic yard; curbing, 60 cents a lineal foot; resetting old curbing, 10 cents a lineal foot; paving, $1.37 a square yard. Macomb brick will be used in the lower course and Galesburg brick in the top course, with Berea curbing.

Albany, N. Y.—Bids for paving Second street, from Ten Broeck to Knox street, 8,890 square yards, with vitrified paving brick, were received as follows: R. H. Strong, Catskill brick and New York cement, $2.05 a square yard; Mulderry Bros., Mack brick and Hoffman cement, $2.04; Callahan & Co., Catskill brick and Hoffman cement, $1.97; T. H. Dumary, Catskill or Canton brick and Hoffman cement, $1.97.

New Orleans, La.—The Mayor was authorized, about Oct. 1, to contract with the Barber Asphalt Paving Company to pave Amelia street, from St. Charles to Carondelet.

Memphis, Tenn.—M. Larkin secured paving contracts Sept. 29 as follows: Brick—Monroe street, 1,730 yards, $3,425.40; Beale street, 4,000 yards, $8,000; Madison street, 4,900 yards, $9,800; Union street, 3,700 yards, $7,365.60. John A. Condon will pave Tennessee street, 2,700 yards, with Fourche granite, for $6,669.

Kansas City, Mo.—Asphalt and brick paving contracts have been awarded as follows: Barber Asphalt Paving Company, Troost avenue, $2.15 a square yard; Fifteenth street, $2.30; Grand avenue, from Thirteenth to Thirty-first street, $2.12; Amie street, $2.12. Gilson Asphaltum Company—Grand avenue, from Twentieth street to the Belt line bridge, $2. Trestrail Paving Company—Cherry street, brick, $1.45.

Toledo, O.—Bids were received Oct. 18 for paving Franklin avenue, from Adams to Bancroft street, and Michigan street, from Adams to Jackson with paving blocks. Bids were presented by F. E. Cole, D. H. Cole, Skidmore & Jennison, Warren-Scharf Asphalt Paving Company, G. H. Bodette, Charles W. McKinney, William McMahon and H. P. Strucker. It will take some little time to determine which bid is the lowest.

Pittsburg, Pa.—Contracts were awarded Sept. 28 for paving, ranging in prices from $1.87 to $1.89 for asphalt, and $1.60 for block stone. Booth & Flinn secured the contract for Bellefonte and Graham street and Flower and Lehigh avenue. The Pennsylvania Asphalt Company was awarded the contract for paving Gangwish and Sherman street, and H. C. Howard for paving Wharton street.

Kansas City, Mo.—The contract for paving Main street, from Nineteenth to Twentieth, with vitrified brick, was awarded Oct. 15 to Tim Brosnahan for $2,317.92. Contracts were awarded on the same day for hexagon block, granitoid and natural stone sidewalks to the following contractors: L. F. McClure, Kansas City Stone Sidewalk Company, T. F. Redmond, Stewart Sidewalk Company, Bandera Flagstone Company, Kansas City Cement Sidewalk Company.

Kansas City, Mo.—Paving contracts were awarded Oct. 5 as follows: Asphalt, Olive street, from the Belt line to Twenty-sixth street, Barber Asphalt Paving company, $2.12 a square yard, or $25,350.96; Panfield avenue, from Ninth to Twelfth street, and Independence avenue, from Walnut to Grand, Barber Asphalt Paving Company, $2.12; grading Harrison street, William Trehey, $1,067.08; grading Twenty-ninth street, from Campbell to Troost, G. K. White, $1,512.

CONTEMPLATED WORK.

Lowell, Mass.—Percy street will be macadamized.

Cleveland, O.—Brick paving is contemplated for portions of Spangle and Dunham avenues, Kinsvater and Cobleigh streets.

West Orange, N. J.—Watchung avenue will be macadamized.

New Britain, Conn.—The issue of $10,000 street improvement bonds is contemplated.

Meriden, Conn.—An appropriation of $30,000 has been made for paving. D. L. Lyon.

Cincinnati, O.—Winslow avenue will be paved with brick and Northern avenue with macadam.

Harrisville, R. I.—At a town meeting held Oct. 9 it was voted to macadamize nine miles of road.

Ardsley, N. Y.—The citizens are considering the question of issuing $25,000 of bonds for paving.

Schenectady, N. Y.—An ordinance was passed Oct. 6 for sheet asphalt paving in Jackson Place.

Seattle, Wash.—Wooden block paving is proposed for Cherry street. R. H. Thomson, City Engineer.

Bristow, Mass.—Paving is contemplated for Lamartine street, from Hogg's bridge to Green street.

Albany, N. Y.—Vitrified brick paving has been recommended for Swan street, from First to Colonie.

Toronto, Ont.—The city engineer has recommended asphalt and brick paving in a numbr of streets.

Cincinnati, O.—New ordinances will be introduced for paving Spring Grove avenue with brick.

Quincy, Mass.—The question of appropriating $18,000 for paving Copeland street is being considered by the council.

Norwalk, O.—Bids have been authorized for the construction of sidewalks. F. W. Christian, City Clerk.

Erie, Pa.—An ordinance is in the councils providing for the curbing of the side streets which are not paved.

Bellevue, Pa.—The question of issuing $36,000 of street improvement bonds will be voted on in November.

Covington, Ky.—The question of issuing $75,000 bonds for brick paving will be voted on at the November election.

Toledo, O.—The Manufacturers' Railway Company has decided to pave Water street the entire length of its tracks.

Hurffville, N. J.—A petition has been granted for the construction of a stone road through this place to Glassboro.

Hartford, Conn.—An appropriation of $4,000 will be asked for macadamizing Farmington avenue as far as Hamilton street.

Allegheny, Pa.—The question of issuing $800,000 of street and water works extension bonds will be voted on Nov. 3.

Sioux City, Ia.—Asphalt paving is contemplated for Nebraska street, from Second to Fourth street. Chairman Westcott.

Brooklyn, N. Y.—The aldermanic grading and paving committee will report favorably on resolutions for repaving a large number of streets with asphalt, macadam and Belgian blocks.

Winona, Minn.—Andrew Rinker, C. E., of Minneapolis has been engaged to check up the grades of this city.

Stapleton (L. I.), N. Y.—Contracts will probably be let in December or January for macadamizing Center street. County Engineer Morrison.

Owensboro, Ky.—The question of issuing $25,000 bonds for paving will be voted on in November. H. M. Talbot, City Engineer.

Paterson, N. J.—Grading, curbing and other improvements are proposed for portions of four streets. Thomas McLean, Street Commissioner.

Brooklyn, N. Y.—The Common Council has declared its intention to repave with asphalt Garfield Place and Quincy and Halsey streets.

Pelham Manor, N. Y.—An appropriation of $29,000 for improving the Pelham road has been made by the Board of Estimate of New York City.

Clinton, Mass.—An appropriation of $2,800 has been made for laying out and constructing Plain street, from High to Main streets.

Woodbury, N. J.—A boulevard is proposed, 100 feet wide, extending from this city by way of German street to the borough of Wenonah.

Midland, Mich.—The question of raising $10,000, to be used in repaving Main street and repairing bridges, will be voted on Nov. 3.

Niles, O.—A resolution has been passed for improving Mechanic street with macadam, from Water to Williams. John L. McDermott, City Clerk.

Saginaw, Mich.—Jefferson street, from Holland avenue to Potter street, will be paved. The material has not yet been decided upon.

Toronto, Ont.—The residents of Penetanguishene have asked for the extension of a country road through a portion of their district.

Easton, Pa.—A resolution has been adopted by the County Commissioners to improve a sample mile of road on three of the main highways of the county.

Pittsburg, Pa.—An ordinance has been passed authorizing the grading, paving and curbing of Homewood avenue, from Shady to Dallas avenue.

New York, N. Y.—A petition has been presented to the Board of Street Opening asking that Fifty-ninth street, between Third and Fifth avenues, be widened.

Whitestone, N. Y.—A petition has been presented to the Board of Trustees to bond this village for $50,000 to macadamize the leading streets and avenues.

Allentown, Pa.—The citizens will vote in November on the question of issuing $350,000 worth of bonds for street improvements and sewers.

Jersey City, N. J.—An appropriation of $20,000 for asphalt paving in a number of streets has been decided upon by the Hudson county freeholders. Thomas McMann, Engineer.

Evanston, Ill.—An improvement association has been formed by the residents of Hinman avenue for the purpose of converting the street into a boulevard.

Richmond Hill, N. Y.—A committee was authorized recently to engage an engineer to prepare specifications for macadamizing Briggs avenue.

Hartford, Conn.—The Board of Street Commissioners have decided to pave, next year, four strets with asphalt and two streets with asphalt blocks.

New Castle, Pa.—A petition from the property-owners on Cochran alley, asking for vitrified brick paving, was referred to the street committee Oct. 19.

Newark, N. J.—Freeholder Van Gieson was authorized, Oct. 19, to pave the gutters on Bloomfield avenue, Montclair and in the same avenue in Bloomfield.

Kennett Square, Pa.—William Hoopes, Francis H. Green and Robert M. Taylor of Westchester have been appointed to lay out a public street in this borough.

Niagara Falls, N. Y.—It was decided Oct. 19 to publish notice of intention of paving Third-st., from Falls to Main-st., with asphalt at a cost of $22,400.

St. Paul, Minn.—A resolution has been adopted by the Park board with a view to the construction of a boulevard on the West Side, from Terrace Park to the high bridge.

Kansas City, Mo.—The board of public works adopted a resolution Oct. 16 to pave Grand-ave., from the Belt Line bridge to the southern city limits, with Trinidad Lake asphalt.

Binghampton, N. Y.—The Warren-Scharf Asphalt Paving Company has been authorized to continue the asphalt pavement on Main-st. 200 feet west from the east curb line of Jarvis-st.

Leavenworth, Kas.—Asphalt paving is contemplated for Fifth-ave. L. W. Beanchumin, who is interested in the asphalt mines at Ardmore, I. T., has submitted a proposition to the property-owners.

New York, N. Y.—Comptroller Fitch was authorized Oct. 6 to issue bonds for $1,000,000, as it is probable that the commissioner of public works may need the money for repairing streets and avenues.

New Haven, Conn.—The Fair Haven and Westfield Railway, which contemplates laying double tracks in Derby avenue, will be required to harden about 2,500 feet of the street with crushed stone or cobble stone as the board of public works may direct.

Plainfield, Conn.—About $30,000 will be expended for macadam roads, which are to be completed within two years. J. Arthur Atwood of Wauregan, Willis D. Rouse of Central Village and Floyd Cranska of Moosup were chosen a committee to superintend and inspect the work.

Bay City, Mich.—The board of public works favors the repaving of Center avenue next spring with asphalt, with the exception of the center of the street, for two feet each side of the car tracks, and the gutters for four feet, which will be paved with brick.

San Francisco, Cal.—The street committee has reported favorably on bitumen paving for Ash, Bryant, California, Laurel, Locust and Maple streets and basalt blocks for Bryant, from Spear to Beale.

Queens County, N. Y.—A petition has been presented to the board of supervisors to include in the county road system and improve the remaining five miles of the Jericho turnpike, from Jericho to the county line.

Chicago, Ill.—An amendment to the Jackson street boulevard ordinance was passed by the city council Oct. 19, which removes the last obstacle in the way of its final acceptance by the South Park board.

Baltimore Md.—Ordinances have been passed for grading, paving and curbing portions of Fulton avenue, and Carey street. Grading and paving is also contemplated for Mount street, from Northwest street to North avenue.

Kansas City, Mo.—The board of public works selected, Oct. 20, brick manufactured at Pittsburg, Kas., for paving Nineteenth street from Tracy to Olive. This is the kind of material that will be used hereafter when brick is specified.

St. Louis, Mo.—Asphalt paving and granitoid sidewalks are being considered for South Broadway. The merchants of that street think that the granitoid walks should be secured first, and then active steps be taken for securing asphalt paving.

Syracuse, N. Y.—The property-owners on E. Genessee street are opposed to the Syracuse Rapid Transit Railway Company paving their proportion of that street with brick and favor a uniform asphalt pavement. The resolution granting the company permission to use brick has been withdrawn.

Burlington, Ia.—The earth that is being removed from the site of the new public library building is being used to fill Third street, between High and Arch, which is two and a half feet below the established grade. It is probable that the council will pass a resolution next year for the completion of the brick paving on that street.

New York, N. Y.—Commissioner Collis has requested the board of park commissioners to place a narrow strip of asphalt on each side of Fifth avenue, between Eighty-fourth and Ninetieth street, thus giving a continuous road of asphalt from the lower end of the city to Harlem. In addition to the $25,000 already appropriated for asphalting the circle at Eighth avenue and Fifty-ninth street another $5,000 has been asked. The lowest bid received on the work was about $30,000.

SEWERS.

York, Pa.—The highway committee awarded the contract for designing a sewerage plan for this city to Joseph L. Wickes of New Brunswick, N. J., for $2,450. The city council has not yet approved the award of the contract and a motion was carried, Oct. 12, to lay it

over indefinitely. The bid of Mr. Wickes was higher than that of a number of other bidders. There were twenty-seven bids presented for designing the plans.

Providence, R. I.—The residents of Edgewood, along the west shore of Narragansett Bay, in the vicinity of Field's Point, are greatly disturbed over the sewage from this city, which is a constant nuisance. An appeal will probably be made to the Legislature by the people who suffer from it. The sewage system has just been completed at a cost of $2,000,000, and it will cost several more millions to continue the system to a safe point down the bay.

CONTEMPLATED WORK.

Creston, Ia.—An 18-inch storm sewer is contemplated in Oak street.

New Haven, Conn.—Sewers are contemplated for five streets. C. W. Kelly, City Engineer.

Albert Lea, Minn.—A sewer on Euclid street 540 feet in length is contemplated.

Pittsfield, Mass.—An appropriation of $5,000 for new sewers has been asked for.

Dubuque, Ia.—Plans and specifications have been approved for a sewer in W. Fifth street.

Moline, Ill.—A sewer is contemplated for Fifth avenue, from First to Second streets.

Council Bluffs, Ia.—The City Council decided, Oct. 20, to construct a sewer in Graham avenue.

Pittsburg, Pa.—Ordinances have been approved for sewers in Horton and Hatfield streets.

Red Wing, Minn.—The Council has voted to construct a sewer on Fourth street early next spring.

Austin, Minn.—The Council has voted to extend the sewer down Railway, south to Dobbins creek.

Windsor, Ont.—Bids will soon be asked for constructing sewers in four streets. William Newman, City Engineer.

Clinton, Mass.—An aporopriation of $3,500 has been made for the completion of the sewer system.

Lyons, N. Y.—The construction of a sewerage system has been recommended at a cost of $70,000.

Scranton, Pa.—An ordinance has been signed for a lateral sewer on Kellum court and Webster avenue.

Sea Isle, N. J.—The Council is considering an ordinance providing for the building of a sewerage system.

Waukesha, Wis.—The question of issuing $16,000 bonds for sewers, paving, etc., is again being considered.

London, Ont.—The City Council has adopted plans for a new sewerage system, which will cost about $200,000.

Belleville, Ill.—Bids will be readvertised for constructing sewers in four streets. Louis Garner, City Engineer.

Uniontown, Pa.—Press reports state that surveys are being made for a sewer system for this place.

Waverly, Ia.—A sewer on Madison street, from the Cedar river to Elm street, thence to Webster, is proposed.

Philadelphia, Pa.—Bids will soon be asked for two small connections with the Manayunk intercepting sewer; estimated cost, $6,000.

Rochester, N. Y.—Plans and specifications have been prepared for a sewer on Lyell avenue, from Warner street to the city line.

Saginaw, Mich.—A sewerage system is proposed for the West Side; also, a sewer in Michigan avenue, to cost $3,120. H. E. Terry, City Engineer.

Winchester, Mass.—The question of constructing better sewers is under discussion. Henry F. Johnston and J. T. Wilson are interested.

Buffalo, N. Y.—The construction of a sewer in Bogardus street, between Bailey avenue and Greene street, has been favorably reported on.

Ottawa, Can.—The question of a sewerage system will be voted on Nov. 3. Willis Chipman, City Engineer, advises the construction of a "separate" system.

Cleveland, O.—Ordinances were passed Oct. 19 providing for the construction of sewers in Walnut and State streets. Howard H. Burgess, City Clerk.

Media, Pa.—Edward H. Hall, President of the Council, has appointed Messrs. Howard, Quinby and Worrall a committee to consider a system of underground sewers.

Newark, N. J.—Notice of intention has been published for the construction of sewers in Warren, S. Seventh, Parker and S. Fourteenth streets and Central avenue.

Providence, R. I.—Plans have been prepared for a sewage disposal plant by precipitation, but the contracts will not be let before next spring. J. H. Shedd, City Engineer.

Red Bank, N. J.—The filtration sewage system has been adopted by this town. The cost of the system will be $13,000, with a yearly cost of $2,450 for maintenance.

Camden, N. J.—Ordinances have been passed by the City Council for constructing an underground drain or culvert, 20x30 inches, in Atlantic avenue and Third and Fourth streets. T. P. Varney, Clerk of Council.

Toledo, O.—Wm. G. Clark, City Engineer of this city, has presented a detailed plan for the proposed sewerage system in Auburndale, which has been adopted. The plan suggested is a temporary system to drain into Ten Mile creek.

Syracuse, N. Y.—Jacob Amos, C. W. Snow, J. W. Yale, W. B. Cogswell, E. C. Stearns, P. J. Brinnekamp and Wing R. Smith have been named a committee by Donald Dey, president of the Chamber of Commerce, to take under consideration the projected improvement of Onondaga creek, with a view to making it part of the sewerage system of this city. Notice of intention has also beeen published for constructing sewers in a number of streets.

Crawfordsville, Ind.—John W. Alvord, City Engineer, The Rookery, Chicago, in company with Mayor Bandel and the council, examined this city, Oct. 19, with a view to determining the most practical plan of draining it by the construction of a sewerage system.

New Orleans, La.—The executive committee of the board of drainage commissioners is getting ready for work again. Major B. M. Harrod, Chief Engineer of the board, favors commencing work on the second section, which would drain the central part of the city.

Boston, Mass.—The common council appropriated $41,000 for sewers in the East district, Oct. 1. Of this $25,000 is to be used in making connections with the metropolitan sewer in East Boston, and $16,000 for sewer outlets in Porter street.

Buffalo, N. Y.—A new plan has been submitted for extending the sewer system to Cassadaya creek, which provides for additional sewers in that section of the city known as Swede Hill, at an additional expenditure of $9,000, making the total proposed expenditure $59,000.

Troy, N. Y.—Resolutions have been favorably reported for tile sewers in Fourteenth, First, Marshall, Tenth and other streets and for the extension of the outfall of the Renssalaer street sewer, from its present terminus to the east side of the Hudson river.

Orange, N. J.—John Reid, Levi Van Buskirk and Ezra C. Williams have been appointed a committee from West Orange to consult with the South Orange authorities concerning the advisability of a joint outlet sewer to tidewater along the line of the Rahway river to Newark Bay.

Indianapolis, Ind.—Resolutions have been adopted for a local sewer in Morris street consisting of 1,630 lineal feet of 2.2x2.3 feet, two 1.10x2.9 feet, brick; also, for local sewer in first alley east of College avenue, consisting of 3,040 lineal feet, 2x3 feet, and 1.8x2.6 feet, brick, 20-18-12-inch pipe.

Baltimore, Md.—Ordinances have been passed appropriating $40,000 for constructing a sewer in Stockholm street, in Southwest Baltimore, and $16,000 for a sewer in Eager street. Bids will soon be asked for a thirty-six and thirty-inch cast iron pipe sewer in Charles street. Janon Fisher, City Commissioner.

Boston, Mass.—An order was passed by the Board of Aldermen, Oct. 19, calling for an appropriation of $52,000 for the following: Forest avenue section of the pumping station, $10,000; sewer outlets in South Boston, $23,000; Shamrock street, $8,000; Back Bay, $8,000. The Board also authorized an issue of $23,000 for connecting the Metropolitan sewer in Charlestown.

Newark, N. J.—Sewers have been recommended as a sanitary necessity by Health Officer Chandler, in Oliver, E. Kinney, Adams, Napoleon, Downing, Market, Van Buren and Nichols streets, and New York avenue. The Passaic Valley Sewage Commissioners visited Rutherford, Oct. 20, to hear from the authorities and City Engineer the conditions of sewage disposal and plans for the future. The engineer explained that Rutherford has three outlets into the Passaic river and one into the Hackensack, the last named exceeding the capacity of the other three. An outlet into one of the rivers is contemplated as an addition to the system.

Asbury Park, N. J.—A plan has been submitted by the Joint Sewer Commission which calls for sewers for the entire township at an estimated cost of $195,000, which will be paid for by the several municipalities in proportion to the direct benefit received. The plan proposed is the chemical precipitation process, with disposal works located near Shark river.

CONTRACTS AWARDED.

Buffalo, N. Y.—The contract for the Meridian street sewer has been awarded to John Harrar for $36,800.

Newport, N. H.—A sewerage system will be constructed in this place by Edward W. Gustine of Manchester, N. H.

Far Rockaway, N. Y.—Bids were received Sept. 22 from seventeen competing firms, and ranging in prices from $23,629 to $44,858.

Oneida, N. Y.—The contract for constructing lateral sewers was awarded Sept. 30 to Fred A. Gott of Buffalo for $5,131.95.

Rochester, N. Y.—Brayer & Albaugh were the only bidders, Oct. 7, for constructing a 24-inch pipe sewer, 2,090 feet long, in Culver road, at $12,228.

Springfield, Mass.—The contract for constructing the Long Hill sewer, with the extension to the Elm street sewer, was awarded Oct. 7 to D. W. Mueller for $5,125.

St. Louis, Mo.—The Hill-O'Meara Construction company was awarded the contract Sept. 26 for constructing the extension to the Tower Grove storm sewer for $41,546.40.

Coffeyville, Kas.—The contract for constructing the sewerage system was awarded Oct. 1 to W. A. Myrick for $18,000 and $1.50 a yard for rock which he is likely to encounter.

Washington, D. C.—Bids were received Oct. 10 for constructing 640 feet of 24-inch pipe sewer, as follows: James McCandlish, $1.35 a lineal foot; John P. Larguey, $1.75; E. G. Gummel, $1.39.

Roselle, N. J.—The contract for constructing 8,500 lineal feet of 12-inch to 8-inch pipe sewers in Bound Brook was awarded Oct. 7 to Headley & Christie, 410 Clinton avenue, Newark, for $7,475.

Albany, N. Y.—The contract for constructing sewers in First and Walter streets was awarded Oct. 19 to William R. Reynolds for $1,600.54. The only other bid was that of Edward F. Dillon, $2,279.36.

Toledo, O.—James H. Doyle secured contracts Oct. 5 for the following: For 818 feet 30-inch sewer, $1.16 a lineal foot; for 934 feet 24-inch sewer, 84 cents; for 403 feet 24-inch sewer, $1; for 679 feet 24-inch sewer, $1.09.

Chester, Pa.—J. B. Helms secured the contracts, Oct. 5, for constructing the Seventh and Ross street sewers at $1.03 a lineal foot, and W. Honan, jr., the contract for the Providence avenue sewer at 99 cents a lineal foot.

Milwaukee, Wis.—The Board of Public Works received ten bids, Oct. 14, for building 1,860 feet of 38x50-inch sewer in Cambridge avenue. The bid of John O. Jones of Racine, $4.22 a foot, was the lowest and the contract will probably be awarded him.

Mt. Vernon, N. Y.—The contract for constructing the Midland avenue drain, consisting of 5,000 feet of open cement drains and about 17,000 feet of tile drains, 2 to 36 inches in diameter, was awarded to the Bellew & Merritt Co. of Tuckahoe, N. Y., for $12,260.

Walden, N. Y.—The contract for furnishing 3,400 lineal feet of 15 and 12-inch sewer pipe was awarded, Oct. 2, to E. S. Sayer of this city, and the contracts for constructing sewers were awarded to G. H. Van Kuren, M. Dupuy, Stephen Stickles, William Tompkins and Edward Mitchell of this city.

Syracuse, N. Y.—Sewer contracts have been awarded as follows: Roberts avenue, from Bellevue to Grand, 18-inch pipe, and a 15-inch pipe sewer in Roberts avenue, from Grand View to Stolp avenue, Richard Barrington, $1,146.90; Midland avenue, trunk sewer, G. D. Grannis, $41,842.

Indianapolis, Ind.—The Board of Public Works awarded the contract, Oct. 15, for constructing a main sewer in Cruse and Dillon streets to Daniel Foley at $4.55 a lineal foot; in first alley south of Fletcher avenue from Dillon to State avenue, Sheehan Bros., $1.82 a lineal foot; in Charles street, from Ray to Sycamore, Chas. H. Carter, $1.62 a lineal foot.

Scranton, Pa.—Bids were received, Oct. 8, for constructing 1,900 feet of 10 and 12-inch sewer in Columbia street, as follows: Peter F. Mulligan, $1.68 a lineal foot, complete; A. Menyetta, $2.01; P. J. Thornton & Co., $1.92; M. J. Gibbons, $1.73; Flanagan & O'Hara, $1.84; the bids include 10 manholes, 5 street basins and 85 house connections; average length, 17 feet to curb line.

Jersey City, N. J.—P. T. Plunkett, 132 Academy avenue, was awarded the contract, Oct. 5, for constructing a sewer in West Side avenue, at the following prices: Thirty-nine-inch brick, oval sewer, 1,220 feet, $2.55; 15-inch vitrified pipe sewer, 3,950 feet, $1.73; rock excavation, 500 cubic yards, 1 cent; concrete, 20 cubic yards, 1 cent; lumber in bottom, 15 M feet, 1 cent; receiving basins, $64.

Erie, Pa.—Contracts have been let to J. McCormick & Son for constructing 18-inch tile sewers in Twelfth street at the following prices: Straight pipe $2.10 per foot, branch pipe $2.20, 9-inch pipe 60 cents, 6-inch pipe 30 cents, manholes $38, catch basins $30. Twelfth street, from Pennsylvania avenue east 675 feet, straight and curved pipe $2 per foot, branch pipe $2.20, 9-inch pipe 50 cents, 6-inch pipe 30 cents, manholes $37, catch basins $30.

St. Paul, Minn.—Contracts for state drainage were awarded, Oct. 15, as follows: Extension of Spring Creek ditch, 16,000 cubic yards. Norman county, John Foley, 9 cents a cubic yard; Mustinka ditch, 20,000 cubic yards, in Grant county, W. E. Blairsted, 8 cents a cubic yard.

CONTRACTS TO BE LET.

Cincinnati, O.—Bids are asked until Dec. 4 for the purchase of $2,038.10 sewer bonds.

Arnprior, Ont.—Bids will be asked next spring for constructing 20,000 feet of 42 by 30 inch brick and twenty-four to six-inch pipe sewers.

Cleveland, O.—Bids are asked until Nov. 13 for the purchase of $35,000 of 5 per cent. sewer bonds. H. L. Rossiter, City Auditor.

Brooklyn, N. Y.—Bids are asked until Nov. 5 for constructing sewers in St. Nicholas avenue and Fortieth street. Theodore B. Willis, Commissioner City Works.

Toledo, O.—Sealed proposals will be received until Nov. 2 for constructing a cylindrical brick sewer in Potter and Seneca streets. Lem P. Harris, City Clerk.

Akron, O.—Sealed proposals will be received until Nov. 7 for furnishing sewer pipe to the city for two years, from Nov. 15, 1896. Deposit, $200. F. C. Wilson, Clerk Board City Commissioners.

WATER-WORKS.

CONTRACTS TO BE LET.

St. Augustine, Fla.—Sealed proposals will be received until Nov. 19 for the construction of a system of water works. B. Genovar, Chairman Board Bond Trustees.

New York, N. Y.—Bids are wanted until Nov. 4 for excavating a tunnel and constructing a masonry dam at Jerome Park reservoir. James C. Duane, President Aqueduct Commissioners.

Oxford, Miss.—Bids are wanted for a 65,000-gallon steel tank, mounted on steel tower, and for furnishing and laying water pipe, setting fire hydrant, etc. W. D. Porter, Secretary Board Aldermen.

Brooklyn, N. Y.—Sealed proposals will be received until Nov. 17 for furnishing and delivering check valves, air valves and stop cocks for 66, 48, 24, 16, 12, 8-inch pipe. Deposit, $2,500. Theodore B. Willis, Commissioner City Works.

Milford, Ill.—Sealed proposals will be received until Nov. 10 for furnishing and constructing a system of mains, hydrants and valves for the water works system. Certified check, 10 per cent. W. S. Button, President Village Board.

Morristown, N. J.—Bids are asked until Nov. 9 for constructing a storage reservoir of about 5,000,000 gallons, with necessary settling and filter basins, etc., on lands of the state of New Jersey, at Morris Plains. Certified check, 5 per cent. Board of Managers of State Hospital of New Jersey.

Long Island City, N. Y.—Commissioner Moore has been directed to advertise for proposals for providing ten hydrants, twenty-two gates and six boxes.

CONTEMPLATED WORK.

Yarmouth, N. S.—A municipal pumping plant is proposed.

Braddock, Pa.—Plans are being made for a new water works system.

Willard, N. Y.—Specifications have been made for a new water works system.

Hammontown, N. J.—The question of water works is being considered by the council.

Highland, Pa.—Bonds have been issued for the construction of a water works system.

Okolona, Miss.—The citizens have voted to construct water works. E. J. Ezell, Councilman.

East Branch, N. Y.—W. H. Cowan is organizing a stock company to put water works in this village.

Pawtucket, R. I.—An appropriation of $9,000 for extending the water mains has been made.

Norwalk, O.—This city has voted to expend $100,000 for the improvement of the water works system.

Philadelphia, Pa.—The resolution to advertise for a $3,000,000 loan for filtration has been passed.

Zanesville, O.—It is stated that new bids will be asked for an 8,000,000 gallon pumping engine.

Hastings, Neb.—The citizens voted unanimously Oct. 6 to issue $8,000 of water works extension bonds.

Aurora, Ill.—The city council contemplates the purchase of a pump for the water works at a cost of $20,000.

Richmond, Va.—An appropriation of $200,000 has been recommended for the purpose of establishing additional pumps.

Rockville, Ont.—A new intake pipe is proposed and $20,000 bonds will be issued to improve and extend the water works.

Albany, N. Y.—The mayor has vetoed the resolutions providing for an issue of $52,000 bonds for the improvement of the water works.

Mt. Carmel, Pa.—The Mt. Carmel Water Company contemplates increasing the water supply by building a storage reservoir and pump.

Mount Joy, Pa.—Press reports state that the borough authorities are in the market for a new boiler, pumps, etc., for the water works.

Halifax, Pa.—A committee has been appointed by council to contract with any party who will agree to construct water works. J. J. Rouch, Secretary Council.

The question of water works will be voted on at the following places: Caledonia, N. Y., Nov. 7; Delta, Pa., Nov. 3; Freedom, Pa., Nov. 3; Columbus, Ga., Feb. 23; Juniata, Pa.; Franklin, Ky., Nov. 3; Franklin, La., Nov. 16; White Sulphur Springs, Mont., November; Elsinore, Cal.; Castleton, N. Y., March.

Millvale, Pa.—Owing to the financial condition of this borough, the opening of bids for a new pump was postponed thirty days at a meeting of the council Oct. 6.

Lancaster, Pa.—City councils have decided to submit to vote, in February, the proposition to increase the city debt $125,000 to be used in improving the water system.

Waltham, Mass.—The purchase of an additional pump is contemplated. Mayor Lyman, Superintendent Brown and Messrs. Doty, Mosher and Libby visited Haverhill recently to see the Worthington pump at work.

The construction of water works is contemplated at the following places: Delta, Pa.; Delaware City, Del.; Lamberton, N. C.; Marion, Ky.; Waverly, Minn.; Oxford, Ala.; Mt. Vernon, Mo.; Arcade, N. Y.; Sharon Springs, N. Y.; Summerville, Ga.

St. Louis, Mo.—A bill was introduced at a meeting of the City Council, Oct. 20, authorizing bids for a filtration plant at the water works of 100,000,000 gallons daily capacity. An appropriation of $2,000,000 is provided for the work.

Omaha, Neb.—The water works system will be enlarged by the construction of a 40-inch water main to Florence, a new pump at the Florence pumping station and a change in the location of the high service pumps now located at Walnut Hill.

New York, N. Y.—Gen. C. H. T. Collis, Commissioner of Public Works, has decided to introduce a new hydrant system, and has invited inventors of the various kinds of hydrants to send to the department illustrations and literature explanatory of hydrants, gate valves and other supplies connected therewith, from which a selection will be made that may be exhibited Nov. 10.

CONTRACTS AWARDED.

Round Lake, N. Y.—The contract for constructing water works was awarded to Flood & Sherrill of Sandy Hill, N. Y.

Toledo, O.—Henry R. Worthington, New York City, was awarded the contract Oct. 3 for a 15,000,000 gallon pump for $52,000.

New Bedford, Mass.—Bids were received Oct. 2 for the new pumping station as follows: Acock & Son, Trenton, N. J., $73,234.50; Stewart & McDermott, New Bedford, $86,796.50; E. W. Everson, Providence, $99,480; Aab & Company, Waltham, $137,352.05.

Holyoke, Pa.—The Holyoke Water Commissioners awarded, Oct. 20, the second part of the iron pipe contract to the National Foundry & Pipe Works of Scottdale, Pa., at $20.35 a ton for 1,800 tons of pipe, and $1.90 per 100 pounds for special castings.

Le Roy, N. Y.—Henry R. Worthington, New York City, was awarded the contract for the pumps for the water works system, Oct. 7, for $4,900. The pumps will have a capacity of 750,000 gallons of water in twenty-four hours. L. J. Richardson was awarded the contract for furnishing the stand pipe.

Boston, Mass.—Contracts were awarded Oct. 16 for furnishing cast iron water pipe to the Howard-Harrison Iron Company for $67,737.50; for 2,000 tons of forty-eight-inch pipe to the Warren Foundry and Machine Company for $36,800.

Binghamton, N. Y.—The contract for a new 12,000,000 gallon pump was awarded to the Holly Manufacturing Company of Lockport, N. Y., for $31,875. The other bids were: Henry R. Worthington, New York City, $32,900; Lake Erie Engineering Works, Buffalo, $38,000; Dickson Manufacturing Company, $44,750; Woodbury Manufacturing Company, Milwaukee, Wis., $46,414.

Kansas City, Mo.—Bids were received Oct. 17 for furnishing and testing a 10,000,000 gallon pumping engine, as follows: E. P. Allis Company, Milwaukee, Wis., $45,500; Barr Pumping Engine Company, Philadelphia, $34,800; Fraser & Chalmers, Chicago, $66,500; Holly Manufacturing Company, Lockport, $37,850 and $39,200; Manistee (Mich.) Iron Works Company, $47,650 and $52,700; Southwark Foundry and Machine Works, Philadelphia, $44,615; Snow Steam Pump Works, Buffalo, $45,500; Henry R. Worthington, New York, $32,500.

St. Louis, Mo.—Bids were received Oct. 6 for water works supplies, as follows: For 75 tons special castings, Howard & Harrison Iron Company, $2,395.60; 200 tons of castings, Harrison Iron company, $6,388; 5,050 tons water pipe, Harrison Iron Company, $100,697; 77 stop valves, St. Louis Iron and Machine Works, $7,401; five stop and check valves, Michigan Brass and Iron Works, $3,090; 4,960 tons water pipe, Harrison Iron Company, $98,902.40; for laying 27,300 feet of water pipe, George P. Prendergast, $24,241.

BRIDGES.

Winston, N. C.—The question of building an iron bridge is being considered by this city.

Arlington, S. C.—A petition has been presented to the council for a new bridge at this place.

Bangor, Me.—Plans are being prepared for a new steel bridge across the Piscataquis river.

Burlington, Ia.—A contract will soon be let for building a new steel bridge across the river.

Pendleton, Ore.—Bids are invited until Nov. 4 for a one-hundred-and-nineteen-foot Howe truss bridge over McCoy crossing.

Fargo, N. D.—Bids are invited until Nov. 15 for constructing five county bridges. County Auditor.

Perth Amboy, N. J.—The question of constructing a bridge over the Rariton river will be voted on Nov. 3. C. C. Howmann.

Cleveland, O.—Plans are being prepared for several important bridges, of which the Center street bridge and the Willet street viaduct are the largest. M. E. Rawson, Chief Engineer.

Point Pleasant, N. J.—A new iron bridge will be built over the Manasquan river between this city and Manasquan.

Grafton, N. D.—A fifty-four-foot combination bridge has been ordered constructed across the Park river by the county commissioners.

Wausau, Wis.—Plans have been prepared for a new steel and iron bridge to have tubular steel abutments filled with cement. C. N. Nutter, City Engineer.

New Orleans, La.—The city engineer has been directed to prepare plans for a bridge over the Claiborne canal at Calhoun street. A. C. Bell, City Engineer.

Green Bay, Wis.—An ordinance has been introduced in the City Council for the issue of $12,000 of bonds for the rebuilding of Main street bridge.

Morristown, N. J.—The Wrought Iron Bridge company, Canton, O., has been awarded the contract for a new bridge over the Whippany river at Abbott avenue.

Knoxville, Ia.—Plans, specifications and bids will be received until Nov. 11 for an iron bridge across the Des Moines river at Red Rock. H. Schivver, Auditor.

Woonsocket, R. I.—Sealed proposals will be received until Nov. 5 for a steel bridge on River street over the Blackstone river. Certified check, $500. Frank H. Mills, City Engineer.

Los Angeles, Cal.—New bids will soon be asked for constructing a 130-foot Pratt truss bridge over the Los Angeles river on the Los Felis road. F. H. Olmstead, City Clerk.

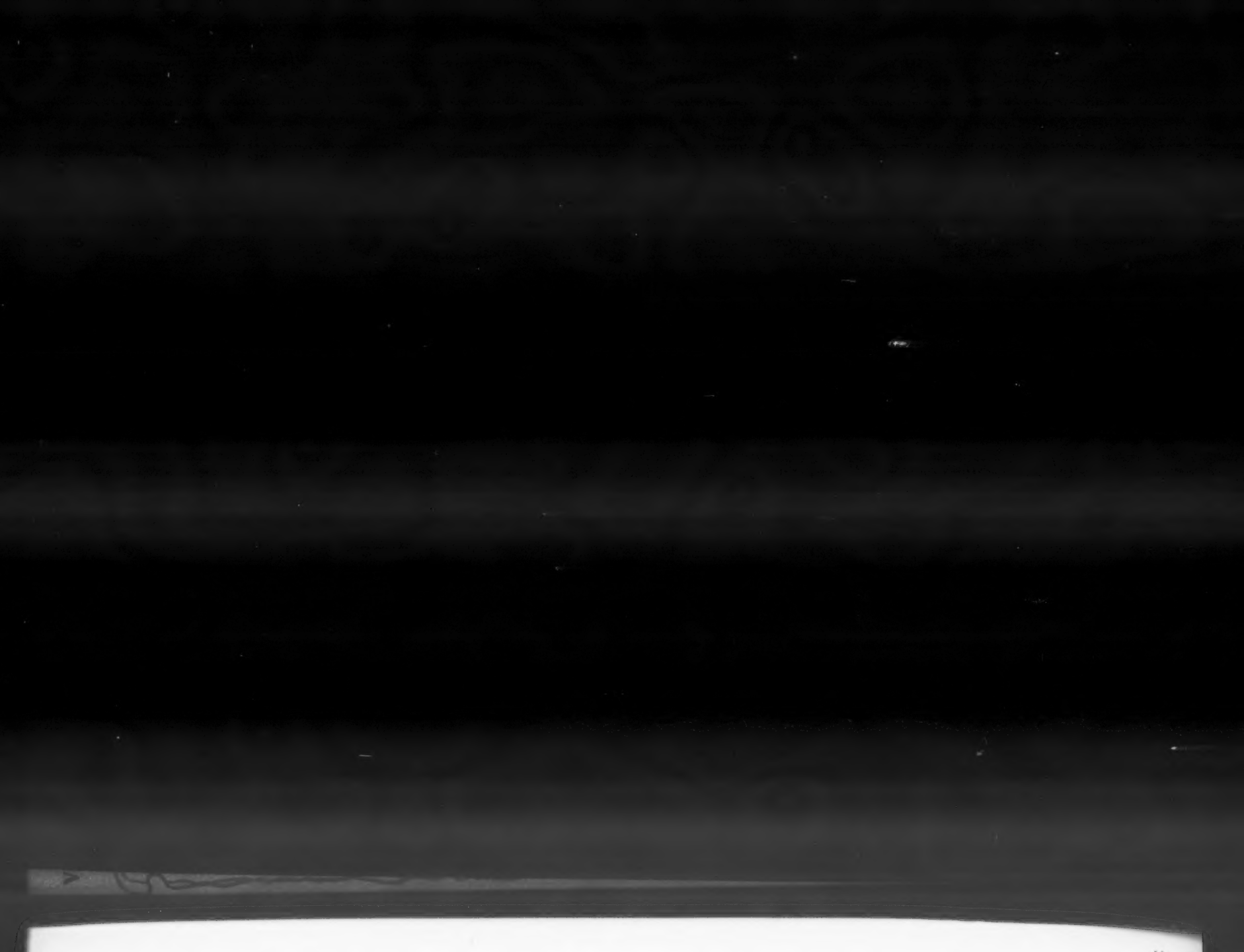
Wadesville, W. Va.—The Wrought Iron Bridge Company, Canton, O., has been awarded the contract for the superstructure of the steel bridge over the north fork of Lee's creek.

Hornellsville, N. Y.—An iron bridge will be built over Crosby creek, at Van Scoter street, to replace the one destroyed recently by high water. F. W. Dalrymple, City Engineer.

St. Johnsville, N. Y.—A joint meeting of the town boards of this town and Minden was held Oct. 6 and it was decided to replace the wooden bridge over the Mokawk with a steel structure.

Providence, R. I.—Sealed proposals will be received until Nov. 5 for constructing a steel highway bridge over the Woonasquatucket river. Certified check, $500. Robert E. Smith, Commissioner Public Works.

Graham, N. C.—A new bridge will be built across Haw creek. S. H. Webb has been appointed to take charge of the matter and let the contract. The bridge will doubtless be steel and iron, with stone abutments.

Harrisburg, Pa.—Viewers have been appointed to make arrangements for the construction of the new bridge over the Susquehanna river at Catawissa, Pa. Joseph G. Swank, William H. Utt and George M. Skeler, County Commissioners.

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